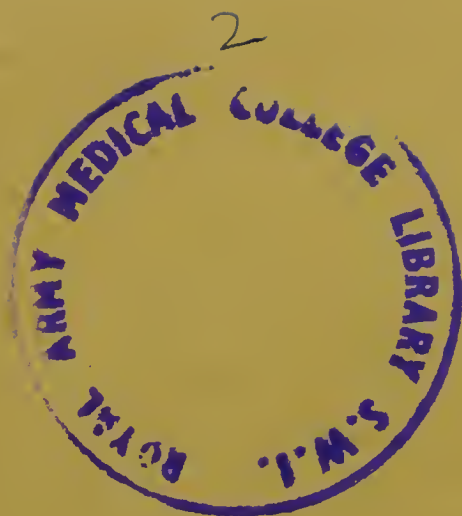


THE
SURGEON'S
POCKET-BOOK

SURGEON-MAJOR J.H. PORTER

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THE SCIENCE AND PRACTICE OF MEDICINE.

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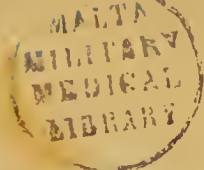
WILLIAM AITKEN, M.D., F.R.S.,

PROFESSOR OF PATHOLOGY IN THE ARMY MEDICAL SCHOOL,
AND EXAMINER IN MEDICINE FOR
H.M.'S ARMY, NAVY, AND E. I.
MEDICAL SERVICES.

In Two Volumes, Royal 8vo, Cloth.

With Numerous Illustrations.

CHARLES GRIFFIN AND COMPANY, LONDON.



THE

SURGEON'S POCKET-BOOK:

AN ESSAY ON THE

BEST TREATMENT OF WOUNDED IN WAR;

FOR WHICH A PRIZE WAS AWARDED BY HER MAJESTY THE QUEEN OF
PRUSSIA AND EMPRESS OF GERMANY.

SPECIALLY ADAPTED FOR THE PUBLIC
MEDICAL SERVICES.

BY

SURGEON-MAJOR J. H. PORTER,

LATE 97TH REGIMENT;

LATE ASSISTANT-PROFESSOR OF MILITARY SURGERY, ARMY MEDICAL SCHOOL, NETLEY;

AND PRINCIPAL MEDICAL OFFICER IN CHARGE OF THE

CABUL FORCE IN THE AFGHAN WAR.

Second Edition.

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TRO

ALICE

BILL

FRANK

PREFACE TO THE SECOND EDITION.

IN issuing a New and Revised Edition of his little Treatise, the author can wish for it no better reception than was so kindly and heartily accorded to the First. The preparation of the work has been a source of great pleasure to him, and he has spared no pains to render it in all respects more complete and helpful than the original Essay, and therefore more worthy of the place which it aspires to hold in the Field-Service Equipment of the Military Medical Officer.

Many new Illustrations of Extemporised Splints, Stretchers, and other useful appliances have been added. Important details of practice, gleaned from the following sources (as well as from others too numerous to specify in full), the author hopes may be found useful in determining the best course to pursue in circumstances of doubt or difficulty, and more especially when the Surgeon is compelled to trust entirely to his own resources and judgment :—

Circular No. 2 : “Reports on Excision of the Head of the Femur for Gun-shot Injury,” by Mr. G. A. Otis of the U.S. Army ;

Professor von Langenbeck’s work “On Gun-shot Injuries of the Hip-Joint” (the result of experiences gained during the Franco-German War of 1870-71) ;

“Medical and Surgical History of the American War of the Rebellion,” part ii. vol. 2, 1876 ; *Surgical History*—“On Wounds of the Abdomen, Pelvis, Shoulder, Elbow-, and Wrist-Joints ;

Professor Longmore’s classical and comprehensive “Treatise on Gun-shot Injuries,” 1876 ;

Professor Esmarch’s “Handbook of Technical Surgery,” 1877 (whence several engravings have been derived) ;

and, lastly, the results of personal visits to the Exhibitions at Brussels, 1876, and Paris, 1878, where numerous ingenious inventions for the relief of the sick and wounded in war were exhibited by many of the most distinguished Surgeons, Naval and Military, of well-nigh every civilized nation in the world.

A short Memorandum kindly contributed by the Author's friend, Professor de Chaumont, will be found under the important subject of Water-Supply and Filtration.

J. H. PORTER

CABUL,

September, 1879.

PREFACE TO THE FIRST EDITION.

HAVING had some experience in the treatment of wounded soldiers during the Crimean campaign, the Indian Mutiny, and the Franco-German War of 1870-71, I was induced to compete for a prize offered by Her Majesty the Queen of Prussia and Empress of Germany, for the best Essay on the "Practical Treatment of the Wounded in War."

The judges, Professors Billroth of Vienna, Baron von Langenbeck of Berlin, and Socin of Basle, awarded a prize to my Essay, which I now publish at the earnest request of my friends in the Medical Profession.

The great difficulty of preparing a work to meet the ever-recurring emergencies of war will, I trust, be sufficient excuse for any shortcomings which may be found in it. The army surgeon of the present day has, as a rule, to deal with the wounded under very different circumstances from his predecessors. Railways, improved transport and field appliances, as well as the privileges of the "Geneva Convention," have given to wounded soldiers better prospects of recovery in many respects; but experience has sufficiently proved that modern surgeons may still be placed, under exceptional circumstances, in no better position for the care of their wounded than were those of former days. On this account I have detailed the surgical rules of the older surgeons, as well as of those of the present day, presuming that my readers will not omit to consider the circumstances of each particular case that falls under their care, and be guided in applying the rules given in this Manual in accordance with them.

Take, for example, the circumstances of men with wounds in or near to a Continental town, with every comfort and appliance at hand, and those of others with similar wounds on such a field as that of Alma, Magdala, or

Coomassie, with the necessity for immediate long transport and exposure : —how different must be the plans of treatment adopted in some of these injuries!

I have included several subjects which might at first sight be considered extraneous to the purpose of a surgical manual; such are : a scale of hospital diets, construction of cooking-places, of camp ovens, extemporary water-filters, and latrines ; but, from experience in the field, I know how important for the present comfort of patients and the ultimate results of their injuries it is that the surgeon should have memoranda on these matters at hand for easy reference. Information on these points formed a portion of the contents of the original Essay, but to the present publication I have also appended the Formulary of Prescriptions which is now in general use in Military Hospitals. I have found the use of this formulary a means of facilitating work and saving time, and have therefore thought it would prove a convenient addition to the Manual.

In the preparation of this Essay I lay no claim to literary merit or originality. My object has been simply to present to the surgeon such information as I myself found the want of during my campaigns ; and in doing so I have extensively made use of the labour of others, to whom I am indebted, but who, like myself, will, I am sure, be well rewarded, if their efforts tend to mitigate in the smallest degree the sufferings of the unfortunate wounded in war.

J. H. PORTER.

WOOLSTON,
May, 1875.

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THE SURGEON'S POCKET-BOOK.

INTRODUCTORY GENERAL REMARKS.

THE duties of the Army Surgeon, at all times responsible, are more especially so in time of war, and much of the success of troops is dependent upon the manner in which they have been executed.

Forethought is required in making suitable suggestions for the preservation of health; and, when sickness and wounds occur, proper organization for the care and treatment of the sufferers. It is not always possible that officers commanding forces in front of an enemy can attend to the strict rules of hygiene, on account of being obliged to take up certain positions with regard to tactics, it is therefore the duty of the responsible surgeon to make the most of such positions, and with the means at his disposal offer such suggestions as will conduce to the health and comfort of those under his care. It is on these occasions, when difficulties have to be overcome, that the resources of the Army Surgeon are severely tested, and his genius and training brilliantly brought out.

Aim of this Work.—Regulations for preserving health do not appear to be required in this essay; it will therefore only be my aim to offer some practical assistance to the Army Surgeon when engaged with troops in time of war, and called upon to exercise his skill in the care of wounded.

Acquaintance with Intended Military Movements.—To facilitate the duties of the Medical Staff during active operations, it is most desirable that the responsible medical officer should be informed by those in authority as to the probable movement of troops, and that he should have some idea of the strategy intended. By being in possession of such information, he may be able to lay out plans for the position of field hospitals, and possibly prevent his ambulances from blocking-up roads, or otherwise causing inconvenience.

Organisation of Transport.—Rules and regulations exist in all civilised countries for the organisation of transport, supply of stores, comforts, and medicines, also of surgical instruments, under their respective departments, as to which it is desirable that the surgeons in the field should have no responsibility (except for such as may be required for immediate use), their

2] THE ART OF EXTEMPORISING APPLIANCES.

object being the care and treatment of those under them, and to whom their entire time ought to be devoted.

Surgeons should make themselves acquainted with the *construction of all transport* for their sick and wounded, so that, in the event of accidents in moving, they can in some measure render temporary assistance; much suffering and delay being frequently occasioned by ignorance on the part of attendants, in consequence of their not being able to set to rights trivial accidents.

In taking the field, either in immediate charge of troops or attached to hospitals, it is essentially necessary to have a careful inspection of every article taken over; to become acquainted with the position or locale of medicines, instruments, medical comforts, bedding, cooking utensils, and such articles as may be required in a hurry, or at night; to detail each medical officer, non-commissioned officer, or hospital orderly, to his respective post, and to see that they are acquainted with their duties; the necessity for doing so cannot be too strongly urged, as it is only by each individual knowing exactly what his duties are, and the relative position of articles in charge, that great confusion, unnecessary unpacking, and trouble can be prevented.

Surgical Instruments should be special objects for care, as without their being in good order the surgeon is of very little use on active service in the field. Guthrie justly remarks, that "a surgeon without his apparatus and equipment is little better than a battery without ammunition."

In dry climates, surgical instruments can be kept free from rust by thorough drying after use, the case being afterwards enclosed in waterproof covering. In moist climates, they should be smeared with mercurial ointment, rubbing off the same when required for use.

The art of extemporising appliances.—The extemporaneous construction of splints, pads, cushions, field-kitchens, hospital huts, latrines, bed-cots, litters, carts, &c., should engage the earnest attention of the army surgeon, as he may be placed in positions where regular artificers are not available; with his knowledge on these matters, and the aid of a few orderlies, he may be able to secure shelter, properly cooked food, and comfort in a short time. He should also be acquainted with the method of pitching tents and marquees, and the amount of space required for each.

It may be remarked that these matters do not belong to the duties of the Army Surgeon; but on service in the field he will find that, unless he is capable of supervising and directing them, much must be left undone, and those under his care must consequently suffer. And if the usual resources fail or are not at hand, he should by extemporaneous expedients succour the wounded and relieve the sick.

An acquaintance with the dress of the soldier may assist in discovering some cause for inability to march or keep up with the others, such as tight collars, or badly-fitting boots, wrinkles in trousers, &c.

The carriage of sick and wounded on stretchers is highly important, and the surgeon should be in a position to instruct those about him, in the event of regularly trained men not being available.

The following instructions have been condensed from rules laid down by Professor Longmore, which can scarcely be improved upon, for the proper carriage of stretchers with three bearers. Since the publication of the first edition of this essay four bearers have been detailed for the carriage of stretchers in our army, as in that of Germany, but it is doubtful if so many men would be available on actual service.

Carriage of stretchers by three men.—For several reasons, it is most desirable that three men should accompany every stretcher which is to be used for carrying wounded from the field of action. Two men are usually told off, but the third is required in case of either of the other two bearers becoming wounded, to act as a relief to the bearers during the transport, and to assist in placing upon the stretcher men who have met with serious fractures of bones from gun-shot. For these latter cases, the presence of a third bearer is of essential importance. A patient with a fractured leg should never be lifted up and put on a stretcher by two bearers only, unless under extreme urgency.

Before attempting to remove a badly-wounded man from the spot where he has fallen, the stretcher should be brought close up to him; the wounded man should not be carried by hand further than can be avoided. In placing the stretcher for this purpose, it should not be laid by the side of the patient, but at his head, and should not be placed cross-wise, but the length of the stretcher should be in the same direction as that in which the wounded man happens to be lying. By this means the patient is readily carried head forward over the canvas on which he is to lie, and the bearers move with a clear view of the stretcher before and between them, until the patient's head is directly over the pillow on which it is to rest.

The front and rear bearers of the conveyance must start with opposite feet. They must not move 'in step,' but, on the contrary, must march out of step, or, as the ordinary expression is, must 'break step.' If the man in front steps off left foot forward, the man in the rear must step off at the same moment right foot forward, or *vice versa*, and this broken step must be maintained throughout the whole distance of the transport.

The bearers must march with a steady but easy step, particularly avoiding that elevation of their bodies which is caused by springing from the fore part of the feet. The foot should be planted without any wavering on the ground at each step, and in moving forward it should only be raised sufficiently to clear the ordinary impediments on its surface. Some bearers, unless this rule is enforced, will make a slight spring in their movements, which spring is of course communicated to the more or less pliable conveyance they are carrying. They do so in the belief that the weight is

4] *RULES FOR PROPER CARRIAGE OF STRETCHERS.*

sustained more easily in consequence of the elastic movement which is thus obtained, but they take no note of its ill effect on the person conveyed. Whether even or uneven as regards measure of time, great care must be taken that the steps of the front and rear bearers are invariably even and alike in distance. If the steps do not well and accurately agree in length, there will constantly be a hasty "catching up" of one or other by his fellow bearer; and the stretcher and patient will be jolted on every occasion when an effort is thus made to readjust the distance. If the bearers march with an exactly corresponding step as regards length, this source of disturbance will be avoided.

When distributing bearers, as far as circumstances permit, men nearly of the same height and strength should be selected for acting together. When a stretcher is supported by men of equal height and proportion, if the ground be level, the stretcher will necessarily assume a horizontal position also, and men possessed of like degrees of strength will carry the weight and move together more evenly. If the ground be uneven, the bearers will have to mutually adapt the height of their respective ends of the conveyance to the irregularities in order to preserve its level condition.

When braces or shoulder-straps are used to assist the bearers in carrying stretchers, care should be taken at starting that they are buckled so that the parts supporting the poles are at equal distances from the surface of the ground.

As most ground over which wounded men have to be carried is likely to present irregularities of surface, it becomes an important matter for bearers to practise the carriage of the stretchers so as to acquire a facility of keeping the stretcher level, notwithstanding that the ground is uneven.

If the ground over which the conveyance has to pass presents a general ascent, and the bearers are of different heights, then the rear or No. 2 bearer should be the taller and stronger man, for his greater height and the greater strength of his arm will be useful in supporting and raising the stretcher up to the level of the end carried by the foremost man. The weight of the stretcher will naturally be thrown in the direction of the man on the lower level.

If the ground presents a general descent, the front or No. 1 bearer should be the taller and stronger, for the same reasons as those just given as regards the No. 2 bearer under the opposite circumstances.

A sick or wounded person on a stretcher should be carried, if the ground be tolerably level, with his face looking toward the direction in which the bearers walk. The front or No. 1 bearer then supports the end of the stretcher at which the patient's feet are placed; the bearer near the patient's head is the rear bearer.

If the bearers have to carry the stretcher up hill, the front bearer should support the end of the stretcher on which the patient's head is placed, excepting under the following circumstances:—

If the bearers have to carry the stretcher down hill, the rear bearer, or No. 2, should support the end on which the patient's head is placed.

The reverse of these positions should be assumed by the bearers both as regards going up hill and going down hill, in case the patient being carried is suffering from a recent fracture of the thigh or leg. The patient's comfort and welfare will be best consulted as a general principle by the arrangements suggested in the previous paragraphs. Although under all circumstances the level position should be sought for as much as possible, still, if the slope of the ground be such that it cannot be attained, it appears desirable that the inclination downwards should be towards the feet rather than towards the head of the patient. But with regard to the exceptions just named, a reverse position of the patient is directed in order to prevent the weight of his body pushing the upper end of the broken bone down upon the helpless and motionless portion of the limb below the seat of the fracture.

No attempt must be made to carry a helpless patient over a high fence or wall, if it can possibly be avoided ; it is always a dangerous proceeding. The danger is of course increased in proportion to the height of the wall or fence. If the fence or wall be high, either a portion of the wall should be thrown down, or a breach in the fence made, so that the patient may be carried through on a stretcher ; or the patient should be carried to a place where a gate or opening does already exist.

In crossing a ditch, dyke, or hollow, the stretcher should be first laid on the ground near its edge. The first bearer then descends. The stretcher with the patient upon it is afterwards advanced, the first bearer in the ditch supporting the front of the stretcher, while its other end rests on the edge of the ground above. While thus supported, the second bearer descends. The two bearers now lift the stretcher to the opposite side, and the fore part being now made to rest on the edge of the ground while the rear part is supported by the second bearer in the ditch, the first bearer is left free to climb up. The stretcher is now pushed or lifted forward on the ground above, and rests there while the second bearer climbs up. The two bearers then carry the stretcher on.

On no account should a stretcher be permitted to be carried on the shoulders of two or four bearers. The evil of such a proceeding is not only that it is difficult to find several bearers of precisely the same height, so that a level position may be secured, but also that the wounded or sick person, if he should happen to fall from such a height, owing to the helpless condition in which such a patient usually is, is not unlikely to sustain a serious aggravation of the injuries he may already be suffering from. Moreover, one of the bearers of the stretcher ought always to have his patient in view, so as to be aware of hæmorrhage, fainting, or other changes requiring attention, taking place, and this cannot be done when the patient is carried on the shoulders.

If the wounded man lying upon a stretcher have to be transferred into an ambulance waggon, a third bearer should invariably be employed to assist in the proceeding.

Means of Extemporaneous Transport.—There are occasions when a sufficient number of stretchers, either “ambulance” or “hospital,” may not be at hand; it will then be necessary to adapt oneself to circumstances, and take advantage of such means as may be present. If near, shipping hammocks and cots may be converted into stretchers by being suspended from single poles, as in figs. 1 and 2, or by a little management they can be arranged to be carried between two poles. The former plan was adopted during the late expedition of British troops in Western Africa, and Staff Surgeon H. Fegan, R.N., mentions that each hammock was fitted with a



Fig. 1.

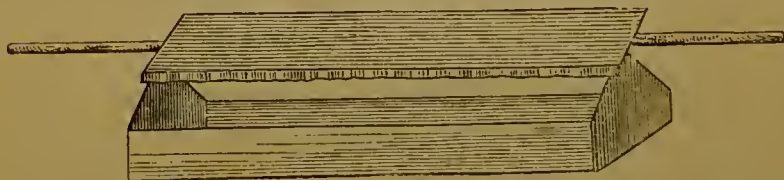


Fig. 2.

Hammocks and Cots used during the Ashantee War, 1873-74, arranged with shades for protection from the sun. (From drawings by Surgeon J. Fleming.)

pillow made of another spare hammock, which, in the event of any emergency, could be easily slung from tree to tree, and thus often proved very useful.

The following stretchers may be constructed on the spot from materials generally available.

“Blankets, by having a loop sewn at each corner, can with two poles or two rifles make temporary conveyances. A loop should be sewn at each corner, and the blanket be then doubled over so that the two loops at each end are brought together; a pole or rifle can be passed through the four loops on one side, and another passed within the doubling of the blanket on the other side.

"In urgent cases a blanket may be used as a means of earriage by four men, one taking hold of each corner. It must first be spread out upon the ground, and the patient laid gently on it in a suitable direction."

Mr. Hamilton of the U.S.A., in writing of blanket litters, recommends "cedar as the best for carrying poles, being light, elastic, and strong. Next to these, pine or ash. Two cross-bars are sufficient. The blanket may be rolled in before the cross-bars are made fast, or, the cross-bars being first secured, the blanket may be 'knotted up' by strings, and if strings cannot otherwise be procured, they may be made by tearing strips from the margin of the blanket."

Dr G. Suckley, U.S.V., says "that he has occasionally in frontier service constructed a temporary litter of two poles cut from the forest, these

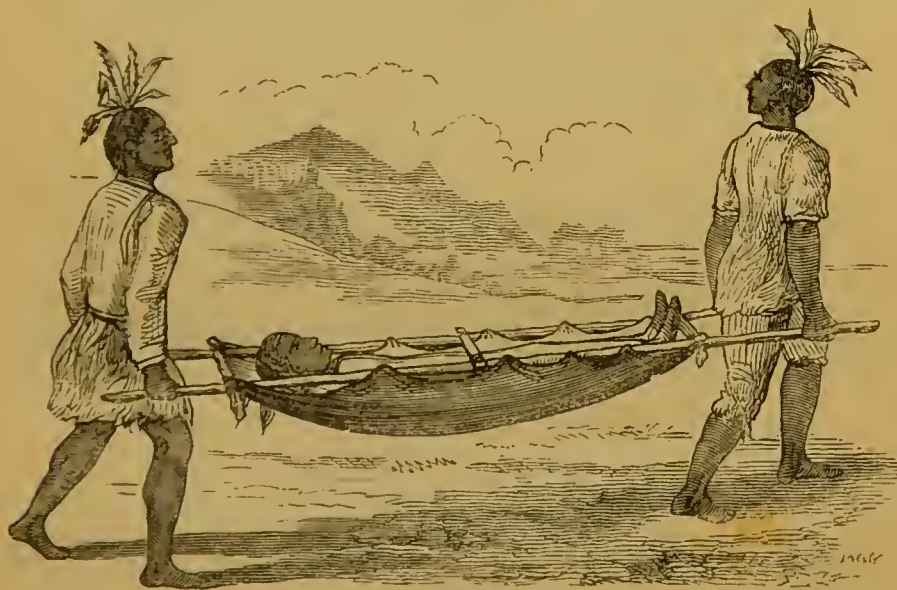


Fig. 3.

being laid upon the edges of a blanket, rolled in, and finally made fast with strong twine, by puncturing the blanket at intervals of a foot along the sides of the poles, and tying the twine strongly on the outside."

Galton recommends a temporary stretcher to be constructed in the following manner: "Cut two stout poles, each 8 feet long, to make its two sides, and three other cross-bars of $2\frac{1}{2}$ feet each, to be lashed to them. Then, supporting this ladder-shaped framework over the sick man as he lies in his

blanket, knot the blanket well to it, and so carry him off palanquin-fashion, as represented in fig. 3. One cross-bar will be just behind his head, another in front of his feet; the middle one will cross his stomach and keep him from falling out, and there will remain two stout handles for the carriers to lay hold of. A kind of waggon-top can easily be made to it with bent boughs and one spare blanket."

"Oat or corn sacks will serve as a canvas bottom to a temporary litter, or, in an emergency, any old pieces of cloth—the fragment of a tent, an overcoat, or even a pair of pantaloons; some of which things can almost always be

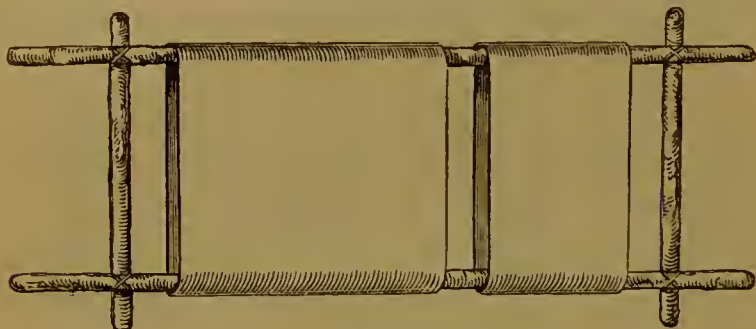


Fig. 4.



Fig. 5.

found on a battle-field. Litters thus constructed also make excellent beds in a hospital tent, when placed upon four crotched sticks driven into the ground."

General Jackson recommended and adopted occasionally a very simple method of conveying the sick, in his expedition against the Indians, viz., to suspend a bull's hide between two muskets, upon which the patient was carried by two or four men, as the case might require.

Fig. 4 represents a very simple stretcher made with two long poles and

two shorter ones laid cross-wise and nailed (or secured by tying), strong cloth, linen, or any other material being stretched across. Boards may be substituted for the cloth, in which case a sack filled with straw, hay, or other soft material must be laid above them. Fig. 5 represents a stretcher composed of two long poles of equal length, with two or three of the men's

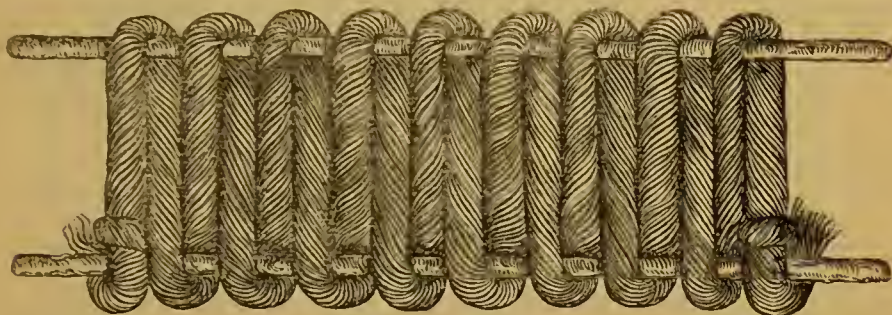


Fig. 6.

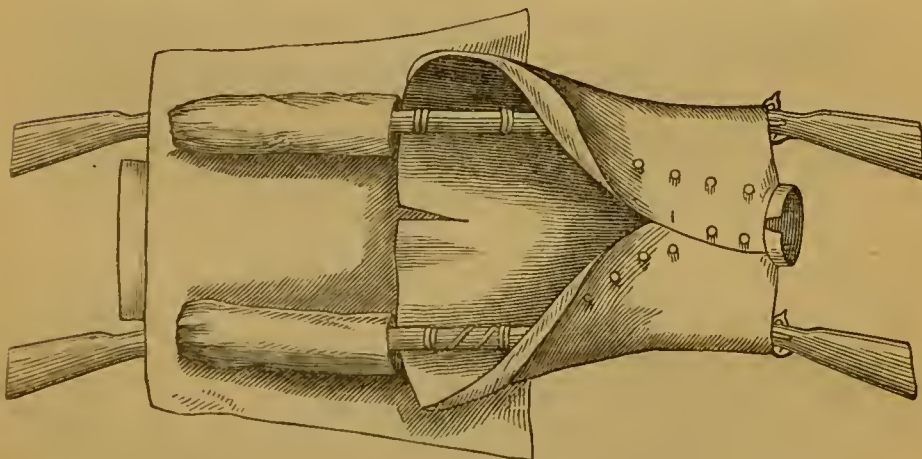


Fig. 7.

belts interlaced. Two cross poles would, of course, keep the long ones apart, and make the contrivance more comfortable, but heavy. Fig. 6 represents a stretcher constructed with a hay or straw rope, which (though troublesome to construct, and requiring experts in the manufacture of the rope), might be found convenient if circumstances admitted of its being made.

Many plans have been devised from time to time for converting men's greatcoats or tunies, and rifles, into temporary means of conveyance, sufficient

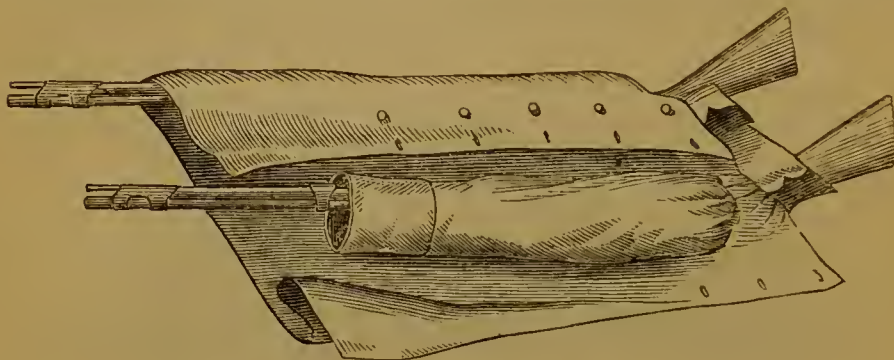


Fig. 8.

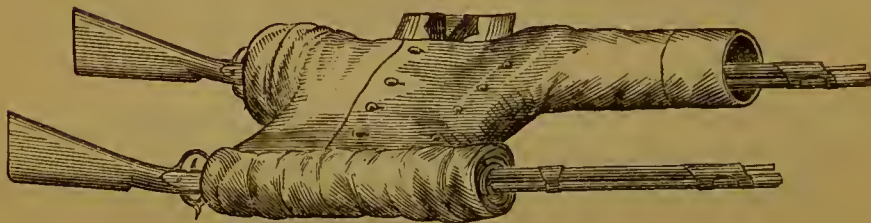


Fig. 9.

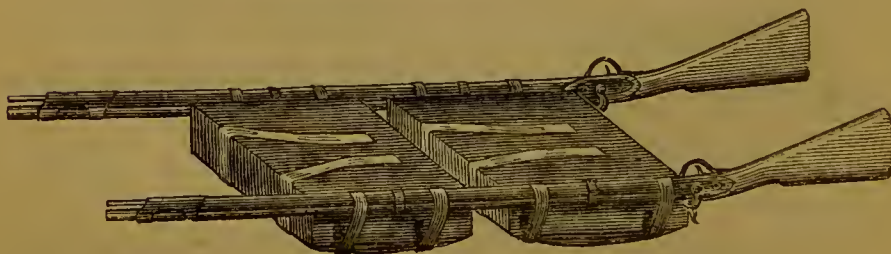


Fig. 10.

in an emergency to carry a wounded soldier from an advanced post to the first line of surgical assistance. Fig 7 represents a stretcher constructed with four rifles and two greatcoats. Two rifles are firmly lashed together

by their barrels, so as to take the place of poles. The sleeves of the coats are then turned into the inside of the garments, and the rifles passed through them, after which each coat is buttoned down the front in the usual way. With one tunic or coat, and two rifles, a short stretcher may be constructed, as shown in figs. 8 and 9, which would answer for a wounded soldier unable to walk, but capable of sitting up, his back being placed against front bearer, and his legs hanging down in front of rear bearer.

Soldiers' knapsacks may be utilised in the formation of stretchers, by being fastened with their straps between poles or rifles, as represented in fig. 10.

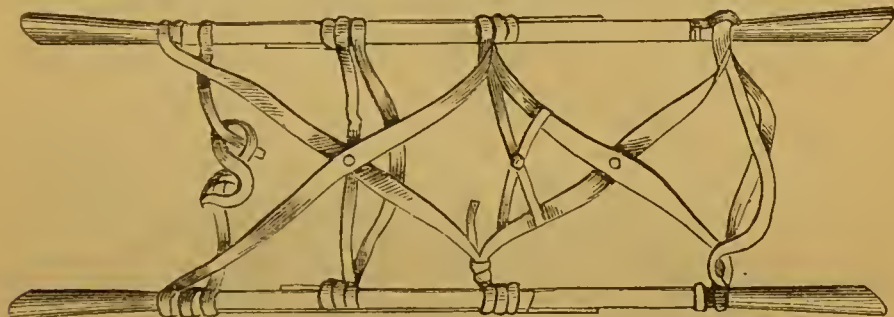


Fig. 11.

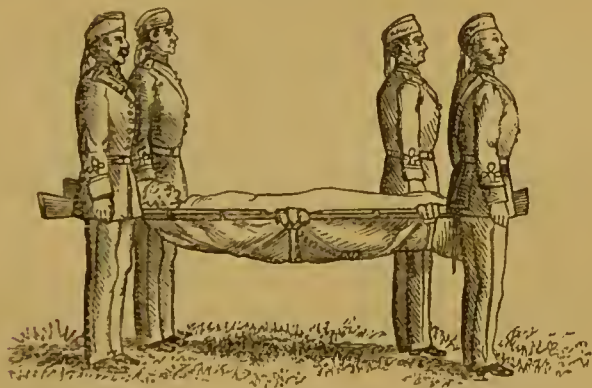


Fig. 12.

Figs. 11 and 12 represent an arrangement of four muskets, with valise equipment and straps, devised by Surgeon-Major Sanderson, 30th Regiment.

Dr Appia suggests that an extempore litter may be made by shirts found in the knapsacks. The poles are to be inserted into the shirt, a number of shirts being placed one above the other. There may be some doubt, he says, as to the solidity or frailty of a litter of this kind, and before placing the patient upon it, it should be tried by a soldier to insure all being in proper order; for nothing can be more distressing than to see a litter break down, or bend under the weight of a wounded and suffering man.

Sailors may in like manner utilise their strong woollen jersies, white smock frocks (jumpers), or serge frocks, by placing them on oars, or boat hooks, the sleeves being turned in.

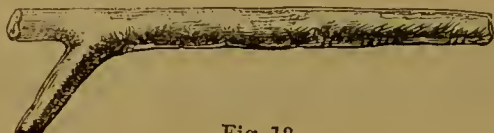


Fig. 13.



Fig. 14.

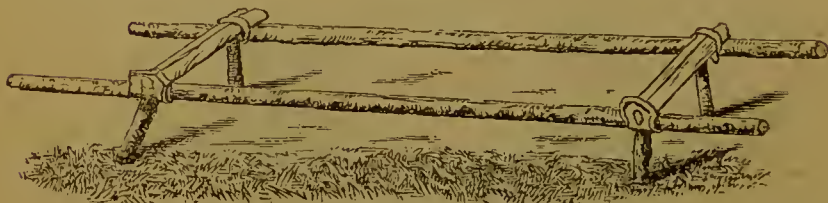


Fig. 15.

Should materials exist for constructing fascines and gabions, excellent litters may be made in the same manner.

Surgeon-Major C. Smith of the Norwegian Army has designed, from strong boughs of trees, several most ingenious stretchers, which have the great advantage of being supported by legs, a most important item in the construction of all stretchers. Fig. 13 represents a portion of a bough, having at its side a branch strong enough to serve as a leg; it requires four such pieces to make a stretcher, each being levelled at one end with a

hatchet or strong knife, and two of them joined together, as shown in fig. 14. These are then attached to side poles by cords, osiers, or other materials, when the framework of a firm stretcher is constructed (fig. 15), on which is to be placed for its bottom a piece of canvas. He has also constructed stretchers with legs, as represented in figs. 16 and 17, all of which

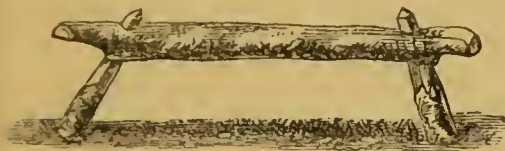


Fig. 16.



Fig. 17.

might answer for improvised hospital cots, the handles being shortened or removed.

Cavalry lances have been recommended for forming the side poles of extemporaneous stretchers; but they will scarcely bear a weight of 10 stone, are too elastic, and therefore unsafe.

Country Carts.—When sufficient wheeled carriage or transport suited for wounded is not available, country carts may be adapted for the purpose by a few simple arrangements.

If materials are procurable, a stretcher may be constructed with ropes (fig. 18) of straw, hay, telegraph wire, or leather belts, and slung within from



Fig. 18.

the sides of the cart, care being taken that the lashings are well secured, but not too tight or too loose; in the former case, the stretcher would receive the impulse from the body of the cart, and in the latter it would knock against its sides.

Should means for constructing a stretcher not be at hand, the cart may be filled with small branches of trees evenly placed, and over them a thick layer of straw, hay, rushes, ferns, dried leaves, or any soft material on which the sufferer may be laid.

A large quantity of fresh straw evenly laid in a cart will form a moderately comfortable conveyance, on which wounded men may be carried for a considerable distance without any ill effects. In India, it is not uncommon to place a dooley on a country cart filled with straw or dried leaves, when bearers are not procurable.

Surgeon-Major Manly, V.C., has described to me an extemporised arrangement for adding to the comfort of the sick when transporting them, which he used in New Zealand. Each drag (a two-wheeled cart) took two wounded. Two hospital bed-cases were filled with fresh fern and placed in the drag, and two wounded men placed on them. If the wound was of the upper extremity, or through the chest, more ferns were placed under the bed-case so as to raise the front half of it, by which means the man could sit in the recumbent position; if of the lower extremities, the other half of the bed was also raised, so as to elevate the legs and thighs above the body. By these arrangements and proper distribution of sick (that is, when a slightly-wounded man is placed alongside one badly wounded), marches of 20 and 25 miles were made with comparative comfort.



Fig. 19.

Surgeon-Major C. Smith has also designed a method for carrying two badly wounded on stretchers in a country hay-wagon. The arrangement is as follows: one end of a rough pole (A, figs. 19 and 20) is lashed to the top side rail (aa) of the wagon outside the side bars, to the front, as in fig. 20; another (B) is similarly lashed to the rear; this being done at both sides, cross poles (cc) are lashed to the free end of these poles; these cross poles support the stretchers which are lashed to them. In this manner the wounded in travelling have the advantage of the spring of the longitudinal poles; to keep this within limits, bands of osier (dd) are placed loosely round them and the top side rail of the wagon.

Railway Hospital Trains.—Railway carriages, vans, or trucks should

be made use of when circumstances admit for the more rapid dispersion of the disabled.

Regular railway transport not being available, it may be necessary to convert baggage and store waggons into suitable transport. Mattresses and bed-sacks filled with straw have been laid on the floor of the waggons, but in consequence of the jarring caused by the vibration of the conveyance, they are not considered comfortable. Loose straw has also been tried, but found defective in elasticity, as it becomes rapidly displaced from under the bodies of the patients, accumulating in heaps, easily broken up and matted. When used, the supply should be liberal. Major-General

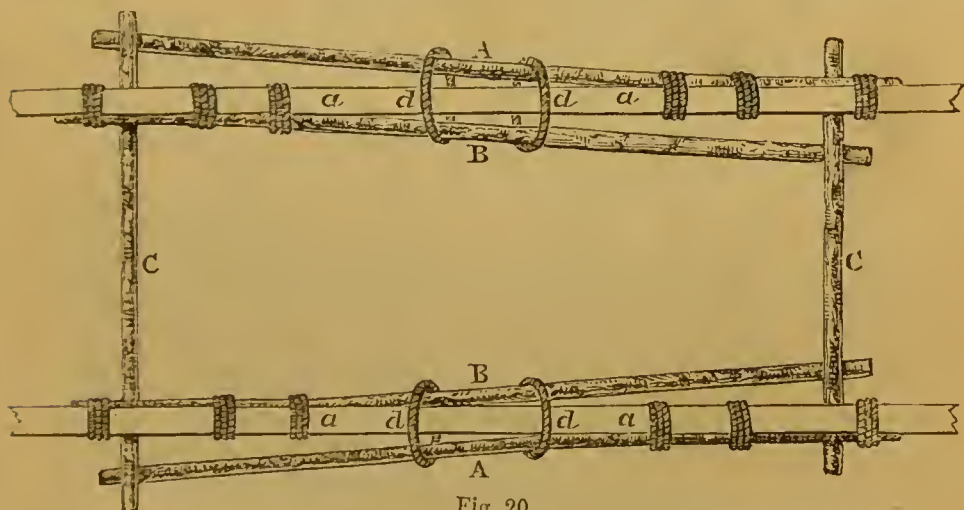


Fig. 20.

Zavodovsky of St Petersburg has adopted the following plan for preventing all shocks from the motion of trains. Two cables (AA, fig. 21), an inch in thickness, are suspended across the top of the car, and secured to iron hooks, that fasten to iron rings $2\frac{1}{2}$ inches below the roof of the car. If hooks and rings are not available, the ropes may be passed through four holes bored in the side of the car. To each of the two ropes is attached at three points (*bbb*) a pole of oak, birch, elm, ash, or other springy wood adapted to the width of the car, but at least 8 feet long and $2\frac{1}{2}$ inches thick in the middle, and $1\frac{3}{4}$ inch at the ends. To the poles thus placed horizontally, there are attached on either side four cords (*cccc*) with knots (*xxxx*), so arranged that they may support on a level the stretchers (*DD*) on which the wounded men are supposed to be reclining. In order that, when the car is in motion, the stretchers with the patients may not sway backward and forward, and

strike against the sides of the car, the lower stretchers are fastened by $1\frac{1}{2}$ inch ropes to three small iron hooks (zzz) screwed into the floor of the conveyance.*

Ship's Hammocks, affording most easy and convenient conveyance, may be utilised for the transport of wounded in railway vans or waggons. The method recommended by the author is to erect uprights at either end inside each waggon, (the walls of railway waggons are usually not sufficiently strong or thick enough to bear the weight of one or more men suspended in hammocks), which should be secured in a temporary manner to the roof and floor, at such a distance apart that the hammock may be fully stretched when hooked or lashed to them. To prevent the lateral motion or swing

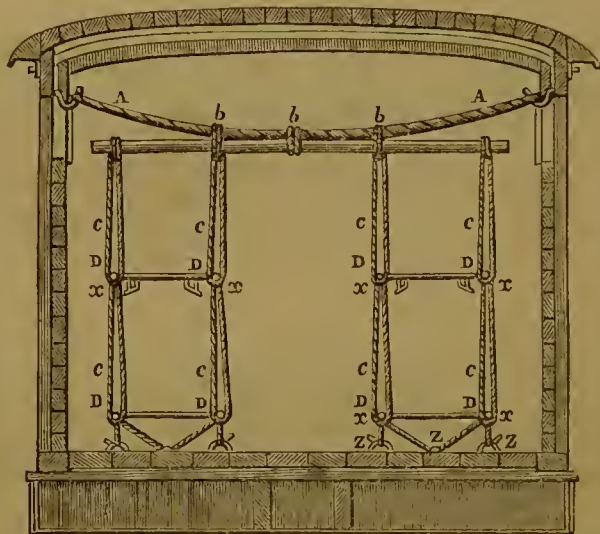


Fig. 21.

which takes place when the waggon is proceeding at speed, that portion of each hammock immediately under the patient's knees should be supported by a stout stick placed horizontally, suspended at either end by cords attached to the roof and again to rings or hooks in the floor.

Four hammocks may thus be suspended in an English "Passenger's railway luggage van."

It might be possible to make use of ship's hammocks for this purpose in

* "Report on a plan for transporting wounded soldiers by railway." G. A. Otis. 1875.

the event of transporting sick or wounded from inland to a port of embarkation, where, no doubt, they could be obtained from the shipping.

Horse litters were used during the American War in 1862, and are well adapted for frontier service; they may be constructed for one or two horses. For the former, one end is supported by a horse or mule, while the other end rests on the ground; with the "two-horse litter" both ends are supported, but as the horses or mules carrying such a contrivance should be well trained, the "one-horse litter" is preferable, and is easily made.

Transport in Mountainous Districts.—In India there are several means for conveying sick or wounded on field service in the hills, such as *dandies* and *jhampan*s, but these do not admit of a patient being placed in the recumbent position. The author some years ago designed a conveyance for badly wounded men, which consists of a cot adapted with a hood and cover, and carried with a *jhampan* frame, as shown in illustration (fig. 22).

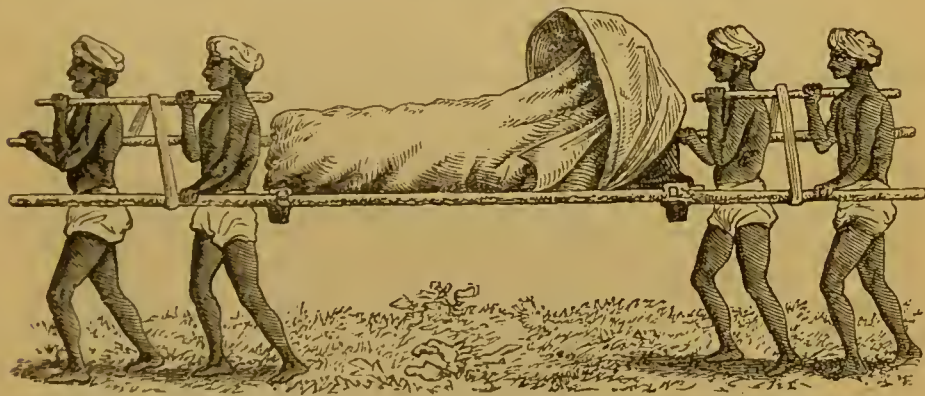


Fig. 22.

This conveyance could be easily improvised from an ordinary bed cot (*charpoy*) and bamboo poles. It has the following advantages, that the recumbent position can be maintained throughout the march; that on the line of march a patient need never be shifted; that the cot answers the purpose of a bed at night; and that a less number of natives is required for its carriage than for any other form of conveyance admitting of a recumbent position. It thus affords all the advantages of a *dhooley*.

Cacolets.—Dr. Appia, who has had great experience with this mode of conveyance, remarks, with reference to the *cacolet with rests*, that it is very rarely of use even in wounds of the trunk, of an arm, or almost of the foot; but that it is impracticable in wounds of the abdomen, in fractures of the thigh, wounds of the knee, and compound fractures of the leg. In cases



Fig. 23.

AMBULANCE LIFT FOR SHIP OR SHORE.

References to the Figure.

1. Hook or eye bolt fixed to the beam over the hatchway.
2. A "double whip," or a purchase with a double block above and a single one below, *a* and *b*; *c*, the hauling part.

such as these, the cacolet *bed* has rendered excellent service. In order to prevent the shaking as much as possible, it is desirable to make the patient sit or lie, upon very pliant cushions, and for this purpose he recommends those made of india-rubber, which he has frequently made use of.

For the *embarking or disembarking* of sick or wounded, where stretcher conveyance is not available or cannot be used, Dr. J. D. Macdonald, F.R.S., R.N., has designed an "ambulance lift for ship or shore" (fig. 23); it appears to be admirably adapted for the purpose. The ham-piece (5 *b*) is well placed, and would give great support where there are injuries of the lower extremities.

SERVICE IN THE FIELD.

In making preparations for the field, compactness should be the first consideration, the object in view being to dispense with luxuries as far as possible, and carry on the duties with the least amount of incumbrance, or, in other words, to have as little impedimenta as circumstances will permit.

It is quite surprising how, on active service, an ingenious surgeon will take advantage of the most trifling circumstance, and how soon he discovers he can do without many things which in time of peace he would have looked upon as indispensable.

Accompanying Troops into Action.—The surgeon should not be hampered with too many things about his own person. What I have generally found most convenient are as follows:—Pocket-case of instruments well furnished with silk, needles, &c., carried in the pouch of the cross-belt; and in a soldier's haversack or small black leather bag, a small supply of lint, two or three bandages, adhesive plaster (Leslie's tape plaister recommended), tourniquet, a flask of wine or brandy, a hypodermic injection syringe, with a small phial containing 2 or 3 drachms of solution of morphia.* A clasp knife will be found most useful for cutting off clothes and shaping splints,

* Morphia in solution is liable to spontaneous change, and is uncertain in its strength if laid up for any time. To obviate this, M. Vidal adds to the solution a quantity of chloral equivalent to twice the weight of the morphia it contains.—"New Remedies," Jan. 1870.

3. A "span" with an eye in the middle for the lower hook of the purchase.

4. A pole $4\frac{1}{2}$ feet long, with which the span is connected.

5. An ordinary hammock attached by the head and foot clews to the extremities of the pole, and further sustained by lanyards, *a*, fixed to a ham-piece, *b*, besides which a strengthening foot piece, *c*, is retained in its place by the foot clews of the hammock, and greater security is given to the patient by the strap and toggle, *d*, holding the sides of the hammock together. The ham-piece, 5 *b*, is tightly secured to the hammock to prevent displacement.

&c. If mounted,* the surgeon can, of course, carry many necessaries in his holster wallets. With these he will be in a position to commence affording relief to any wounded. An orderly should be in close attendance with a further supply (which may be carried in a knapsack† adapted to the purpose), and which should consist of flannel and calico bandages, lint, charpie, splints such as can be adapted for long or short bones, plaster of Paris, a metal spoon, oil or spermaceti ointment, tincture of the perchloride of iron, chloroform, sponges, candles, tourniquets, tincture of opium or solution of morphia, a drinking cup, matches, tow, essence of beef, a pencil and diagnosing cards; but, above all, he should have a large flask of fresh water. These can be replenished from the hospital panniers, which should be kept well out of fire, but easily communicated with.

Early surgical assistance in the field is of first importance, and requires consideration as to how it may be regulated in an orderly and continuous manner. It is difficult to lay down fixed rules suited to all occasions and contingencies for rendering aid to the wounded soldier, but of late years in European warfare, when well and systematically-conducted arrangements have been made, there have been four kinds of help-stations organised and placed as follows ("Longmore on Gun-shot Injuries," 1877, p. 460):—

"*Position of the First or 'Field Station.'*"—This will be in the immediate rear of the fighting line, moving as the combatants move, whether advancing or retiring. The order of service to be rendered in this the first zone of surgical assistance will be, to pick up the wounded, to attend to the wants of extreme urgency, to carry them to the dressing-stations, to apply primary dressings, to remove the patients when temporarily dressed to the field hospitals, and to supply definite hospital treatment."

Operations, such as amputation or excision, should not be performed at the first line of surgical assistance; not but that, if they could be done, they might be attended with greater success than at a later period, but they would take up too much of the time of the surgeon, while other wounded would be obliged to do without aid. It is also of the greatest importance that the surgeon should keep up with the troops in action, and on no account lose sight of them, his presence with his battalion after an action being required to dress slightly wounded, and give confidence to the men.

"*Position of the Second or 'Transfer Station.'*"—It should be sufficiently clear of rifle-shot from the combatant force opposed to the troops in whose service it is formed—from 700 to 900 yards. It should approach the front as closely as is consistent with the requirements just named, so that the

* Dr E. Hermant of the Belgian cavalry has designed saddle-bags, which are most convenient, on account of there being no difficulty in getting at any portion of their contents. A specimen is in the Museum, Netley Hospital.

† In the German army a hospital attendant carries a knapsack containing supplies of articles likely to be required.

wounded may be got into the waggons as early as possible, and the bearers left free to return to the front for more wounded; and it should be at a place practicable for wheeled vehicles. If any surgical help be given, it should only be of the same kind as that at the fighting line; for arrest of hæmorrhage, if it be active; for impromptu protection of broken limbs, if none has been previously applied; or for hasty readjustment.

“Position of the Third or ‘Dressing Station.’—This station should be out of the range of artillery fire from the enemy, about 1000 yards in rear of ‘transfer station,’ but at a spot easily reached by wheeled vehicles, and on the road towards the field hospital station, near a supply of water if possible.

“The duties at this station consist in successive examination of the wounded, those requiring surgical operations, as amputation, ligature of arteries, adjusting of fractured bones, &c., should be placed in one category, and those only requiring simple dressings in another; mortally wounded should be placed where they will be least disturbed, and their condition rendered as easy as possible.”

As soon as the wounded have received whatever preliminary operative interference, dressing, or other surgical attention they need, the surgeon should write in a few words the conditions found, on the “tablet,” “specification tallies,” or “diagnosing card,” which should be in general use in all armies for attaching to each wounded soldier, and which might either be worn by him from the time he enters the service in the field, or be carried with the hospital and distributed by the surgeon when required. The former plan would no doubt be the best, as there would be more certainty of the cards, or at least some of them, being present; whereas, if kept with the hospital, they may not be available when required. The information recorded on these cards is of the greatest importance, preventing much suffering and delay when the wounded reach the position where operative measures are to be adopted, the surgeon there being able to ascertain information regarding condition of wound from attached card, without exposing the patient to further suffering.

With regard to performing operations at the dressing-stations, Pirogoff, the distinguished Russian surgeon, has made some valuable remarks. He says: “Surgical work done in the heat of battle is but waste of power, and scarcely less useless than the feverish practice of the bandage-places.” Discrediting the value of the operations done in the heat of battle, he adds, as a further reason why they should not be attempted, “that the rapid firing of recent weapons produces such a simultaneous crowd of wounded that ambulances are immediately thronged, and reliable diagnosis between the cases suitable for operation and for conservative surgery is rendered impossible.” He therefore assigns to the surgeon at the bandage-places the duty of using means to avert danger, of transmitting the wounded ticketed with diagnosis cards to prevent all further painful and unnecessary examination,

and of dividing the wounded into "those hopelessly injured, those requiring prompt attention, those fit for transport, and the slightly wounded." Professor Billroth, of Vienna, is of the same opinion.

*"Position of Fourth or 'Field-hospital Station.'—*This should be about 2 to 4 miles in rear of the combatants, and, if possible, so selected that it will not be brought into the sphere of fighting, or interfere with the movements of the troops."

The wounded will be brought thence by wheeled transports, when a temporary hospital may be established where primary operations may be performed, or such wounded as can bear the journey may be transferred to other hospitals further in rear. It is difficult to lay down any decided plan as to where wounded should be treated or hospitals established after an engagement, as the positions of towns, villages, farm-houses, with regard to the battle-field, will alter any preconceived ideas or arrangements.

Fuel and Water.—The want of fuel and water is a most serious matter where wounded are concerned, even more so than shelter; but where there are houses they are sure to be procurable.

Shelter.—The importance of looking out for shelter must be apparent. In open countries, dwelling-houses, barns, stables, and outhouses may be secured for the protection and comfort of the wounded. In towns, large buildings such as school-houses, churches, public establishments, or barracks, may be made use of for collecting the wounded for immediate relief, but it is *absolutely necessary* that they should be distributed as soon as possible into tents, or smaller buildings, as the permanent collection of wounded in one place is injurious. "The system of distributing the wounded," remarks Billroth, "which of late has been conducted with excellent results, requires great circumspection and trouble from the superior medical authorities, but it has proved advantageous." Churches and school-houses are objected to in consequence of being seldom well ventilated, and in the former not only does the "dim religious light" depress the patients, but the cold and draughtiness expose them to many dangers.

First Relief to Wounded at Sieges.—At sieges, the wounded should receive their first dressings in the trenches, whence they should be conveyed to temporary hospitals close by, where primary operations can be performed, and such wounded as are found in a condition to move sent on to the field-hospitals for more permanent treatment. During the siege of Sevastopol, the surgeons of the English Army were provided with shelters, or shot-proof "bunks," where they rendered most excellent service to the wounded.

After an Engagement with the Enemy.—An engagement having taken place, the surgeon is called upon to attend the wounded; he will have many points to consider as each man comes before him, and these must be rapidly turned over in his mind, and as quickly acted upon. There may be violent hæmorrhage, extreme constitutional alarm, or what is generally known as

“shock,” pain, insensibility, fracture, laceration of soft parts, or internal injury of some kind.

Surrounded by a great number of wounded, the surgeon may feel puzzled to know what condition he should relieve first.

Wounded to be first relieved.—In all probability he will have to afford assistance as he meets the wounded, or as they are brought to him; but should he be in a position to make a selection, those suffering from hæmorrhage should be his first consideration, while those otherwise wounded should have warm drinks or stimulants administered, and with consolation and a few kind words they will be in a more comfortable position and better able to bear the pain of having their wounds dressed when their turn comes.

Hæmorrhage.—The expedients for arresting hæmorrhage are considered under the subject “Hæmorrhage.”

Shock.—Constitutional alarm or shock is best relieved by the administration of cordials, stimulants, tea, or beef tea.

Acute Anæmia.—Anæmia or syncope from hæmorrhage may require, if practicable, transfusion, which is advocated by many authorities, and to perform the operation ingenious instruments have been invented by Drs. Neudorfer, Roussel, Aveling, and others. M. Verneuil has used with success the hypodermic injection of ten drops of sulphuric ether in such cases. He considers transfusion as dangerous, and likely to infect with putrefactive matter.

The pain of a gun-shot wound is sometimes excruciating, especially when a large nerve has been wounded, or the weather is very cold. Heretofore it was the custom to administer opium internally in some form or another; but the use of morphia in solution, given in the form of a hypodermic injection, has been found to afford such speedy relief, to be so convenient of administration, and so portable, that it is now generally used in warfare. The solution is best made with distilled water, in proportion of 1 grain to 24 minims—6 minims for one injection. During the late Franco-German war, some of the British ambulances used the hypodermic injection of morphia with most happy results.

Hypodermic Syringes.—The points of the ordinary hypodermic syringe are somewhat like a grooved needle, and are difficult to introduce; it is therefore recommended that in making a selection of these invaluable instruments the point be flattened, like the point of a lancet, which requires very little force for introduction.

The metal ends are very liable to become detached from the glass, in consequence of the cement dissolving; the instrument is therefore rendered more serviceable and lasting by having a band of metal on either side uniting them together.

First Dressings.—Urgent cases having been attended to, the surgeon will proceed to put up fractures, which will require much skill and care. He

can then afford aid to the more lightly wounded, who, in all probability, will require little more than a piece of wet lint, cotton-wadding, jute, or charpie, secured by a bandage or roller. It may be well to observe, that any dressing had better be omitted rather than have it applied with dirty fingers or dirty water. *Lint* forms the most ordinary dressing, but in making a selection of it, it would be well to avoid that quality which requires cutting, and will not tear evenly. The old pattern lint is decidedly the best. Surgeon-Major R. Wolseley, in advocating the use of antiseptic dressings in gun-shot wounds on the field of battle, suggests as a means for making such available, that the Rangoon oil, which each soldier carries in a small bottle as part of his equipment, be made use of as a dressing. It being, as he says, a powerful antiseptic, a soldier would thus have at his command one of the very best applications he could require. This is a most valuable suggestion.

Bandages.—The insufficient supply of bandages is generally much felt



Fig. 24.

after engagements, as it is impossible for the surgeon or his attendants to have at hand a number equal to the necessity of the occasion; and though a supply may have been provided, they will very likely not be forthcoming when required. During the latter part of the Crimean War and the war in New Zealand, the English troops were furnished when going into action with a strip of bandage 4 feet by 3 inches, a piece of lint 12 by 3 inches, and 4 pins, which they carried in their packs. This arrangement I do not approve of, as a soldier may be separated from his pack.

Esmarch Bandage.—Professor Esmarch has designed a triangular bandage (fig. 24), which can be applied in thirty-two different ways. It measures 4 feet at its base by 2 feet 10 inches. It can be folded flat, and therefore takes up but little space. The bandage is inclosed in a waterproof envelope, which protects it, and no doubt would be found useful as part of the dressing.

At the Brussels Exhibition, 1876, he exhibited a "first dressing," com-

posed of one triangular bandage with a safety pin ; four small packets of 10 per cent. salicylised cotton charpie enclosed in varnished paper ; one piece of salicylised gauze bandage, about $4\frac{1}{2}$ inches broad by 1 yard long ; and four common pins. The whole were made up into a small packet, and wrapped in waxed paper.

Each Soldier to be provided with a Bandage.—I have long been of opinion that each soldier going on active service should be provided with one of these bandages, or a strip of bandage and piece of lint ; that a certain position in a soldier's tunic should be selected in which this bandage might be deposited, so that the man himself, the surgeon, his attendant or comrade, might know exactly where to find it.

The writer has endeavoured to adapt it as a pad for the right shoulder, to receive the stock of the rifle, and thereby assist in preventing the severe bruising which is frequently caused after continued firing by the kicking of the rifle, but it is too bulky.

Lights.—It frequently happens in service that the surgeon may not be provided at night with lamps or candles for dressing wounds. The writer has been in this dilemma in advanced works. He has since improvised a lamp from the oil-bottle referred to by Dr. Wolseley by simply placing a piece of lint in it, and a pin cross ways, so as to prevent the lint from slipping in. By means of this lamp (fig. 25) he has, in a darkened room, been able to ligature a carotid or femoral artery. For improvising a lamp and reflector an apparatus with a candle and spoon, as shown in fig. 26, might be constructed.



Fig. 25.



Fig. 26.

GUN-SHOT FRACTURES.

Gun-shot Fractures, especially of the lower extremities, are always sources of great anxiety on the field of battle, as the sufferer must, as a rule, undergo transport, and unless the limb or limbs are securely "put up," even in a temporary manner, the consequences will be most serious, often rendering slight injuries severe and complicated.

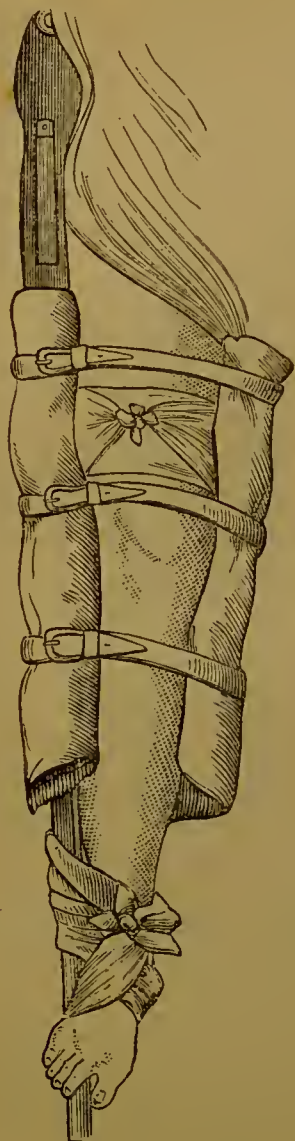


Fig. 27.

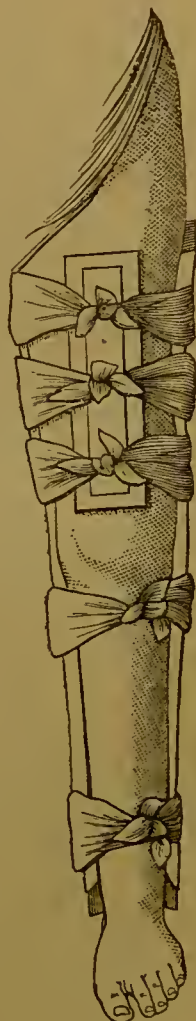


Fig. 28.

Extemporary Appliances.—It is not always possible to have at hand special splints, plaster of Paris, or any of the numerous contrivances for securing fractures; the surgeon will, in consequence, frequently be obliged to make use of such expedients as circumstances will admit of, or, in other words, improvise splints from materials generally available on the field of battle. For this purpose, in a case of *fracture of the thigh*, a rifle may be placed along the outside of the limb (fig. 27), extending from the axilla to the foot. It should be secured by a bandage round the trunk, and by another round the foot and ankle; a soldier's greatcoat or cape should then be folded, so as to partially surround the limb and the rifle, the whole being secured by means of the straps of the greatcoat, bandages, or anything suited for the purpose. The butt end of the rifle should be placed in the axilla.



Fig. 29.

Another plan for putting up a fractured thigh is with two long splints, one reaching from the hip to the heel, and the other from the perineum to the heel, a third short one being placed in front, and the whole secured by straps, handkerchiefs, or bandages (fig. 28). Both feet should be tied together.

Esmarch, in putting up fractures of the thigh on the field, makes use of the soldier's long boot, (all the troops in the German army wear the Wellington boot), to which he attaches his means of extension, and gives support to the leg. He cuts the boot down the front as far as the instep; the sole of the

boot is then perforated in two places in front of the heel, through which the extension cord or bandage is passed, the soft *upper* is then rolled backwards on a stick or short sword (fig. 29) and secured, the foot is then placed in

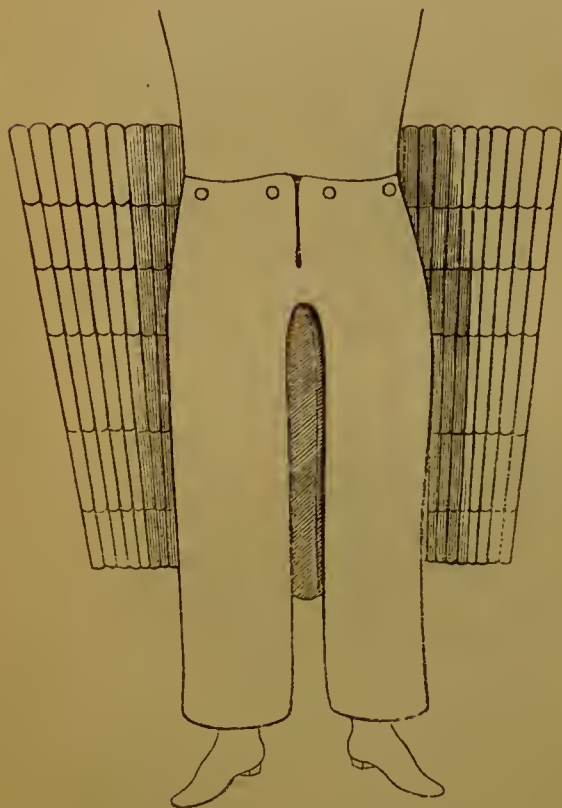


Fig. 30.

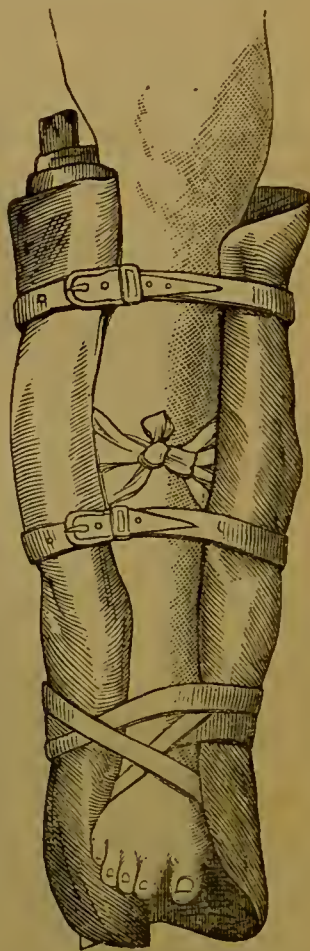


Fig. 31.

the boot and secured with an ordinary bandage. This having been done, and extension made to the end of the stretcher, it will be found that the sword or stick on which the *upper* is rolled will rest on the side poles of the

stretcher, and give great support to the leg. Counter extension is made by a perineal bandage (piece of cloth or waist-belt) secured to the upper crossbar of stretcher, a strong elastic ring intervening between knot and perineal bandage and cross-bar of stretcher. The fractured thigh bone is to be surrounded with a scored splint and secured with two or three turns of a bandage.

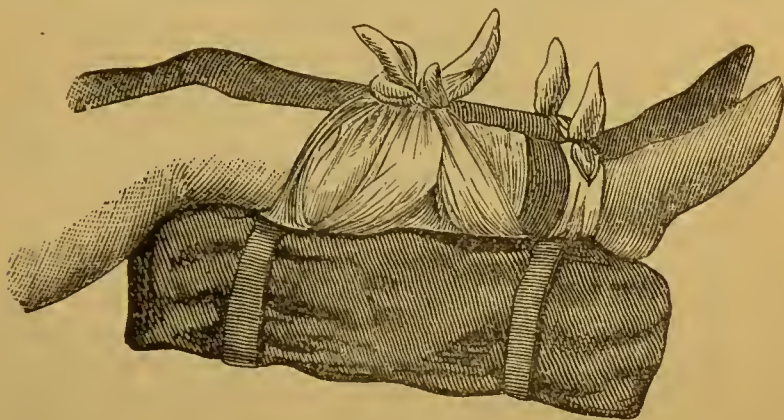


Fig. 32.

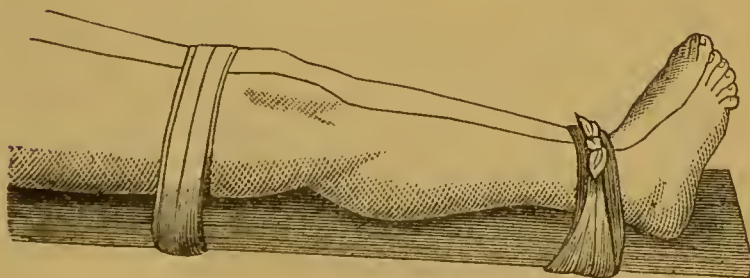


Fig. 33.

Straw Mats.—Dr. Port suggests the use of straw mats for transporting patients with fracture of the thigh. He directs that the mat should be spread out on the ground, and the injured man laid on it in such a manner that the upper edge of the mat will project a little above the crests of the hip bones; a chaff or sand bag is to be placed between the thighs, the sides of the mat wrapped round the pelvis and thighs, and the whole secured to the injured man's body with three cords (fig. 30).

For fractures of the leg, the following extemporaneous splints may be constructed with very little trouble. Fig. 31 is intended to represent a

fracture of the leg secured with a splint placed along the outside of the limb, and the whole rolled in a greatcoat or cape fastened by straps or pieces of bandage.

Figs. 32 and 33 speak for themselves. In one the legs are tied together

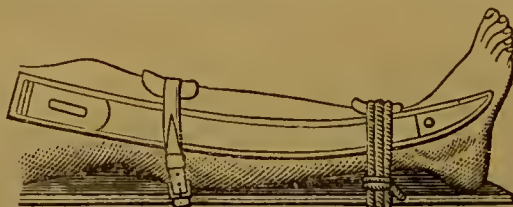


Fig. 34.



Fig. 35.



Fig. 36.

at the ankles, and placed on a soldier's knapsack, and in the other the legs are also tied together, but they are placed on a board. In securing limbs in such positions, some soft material should be placed underneath them and in between, so as to fill up spaces and make the parts comfortable. If nothing better can be found, hay or straw will answer.

A fractured leg may easily be put up with the scabbard of a sword and a board, as represented in fig. 34, or with two bayonets, as in figs. 35 and 36.

A roll of straw makes a capital temporary splint, placed along the outside of the limbs, as shown in fig. 37.

When a piece of cloth and two rolls of straw are available, a most comfortable splint may be constructed by placing the limb in the centre of the

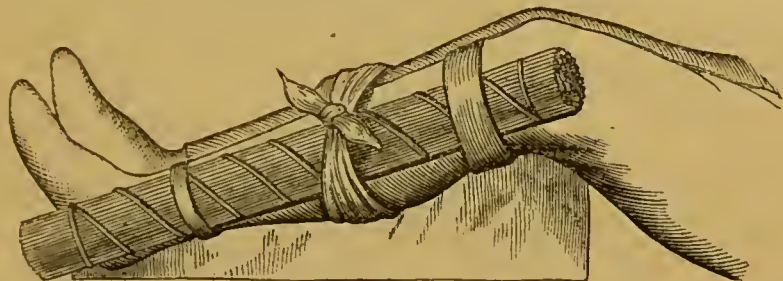


Fig. 37.



Fig. 38.



Fig. 39.

cloth, and rolling bundles of straw of equal thickness (and the length of the limb) until they come in contact with the fractured member (fig. 38).

Fractures of the arm may be "put up" with very thin bundles of straw lined with cotton wool or wadding, or they may be enveloped in straw, in which case it is of course necessary to have a soft lining.

Fig. 39 represents a fracture of the upper arm "put up" with a bayonet and its scabbard, which, if nothing better can be found, will prevent the limb from being further damaged in transport.

Should thin pieces of board be available, such as the lining boards of a

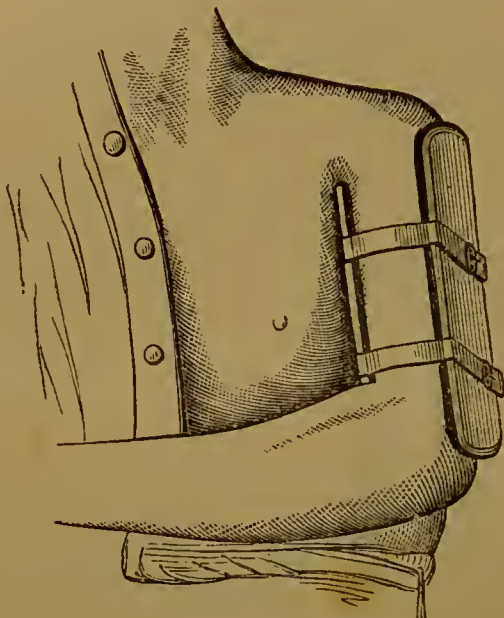


Fig. 40.

soldier's knapsack, they may be applied as represented in fig. 40. The forearm being flexed, one splint is placed on the inside of the arm, reaching from the axilla to the inner condyle, a second long splint is placed on the outside of the arm, reaching from the acromion to the external condyle, and a third may be placed on the front or behind; these may be secured by straps or bandages. The forearm should be supported with a sling.

Fractures of the lower end of humerus are best secured with an inside rectangular splint, the straight splint not giving sufficient support.

Fractures of the fore-arm may be put up with two light splints, one placed in front and the other behind, and as a temporary contrivance the

splints may extend beyond the fingers, so as to give perfect support to the hand and wrist during transport. On arrival at a permanent hospital, or any place where proper splints are procurable, the temporary ones should be replaced by such as are in use and recommended for particular fractures.

SPLINTS.

It has always been a special point in preparing surgical appliances for war to provide splints of materials which will be sufficiently strong to support the largest bones when fractured or shattered, and at the same time be light, easily carried, and capable of being applied with facility.

The old-fashioned *wooden scored splints* were at one time much used, but they were liable to be rendered unserviceable by exposure to wet or from the

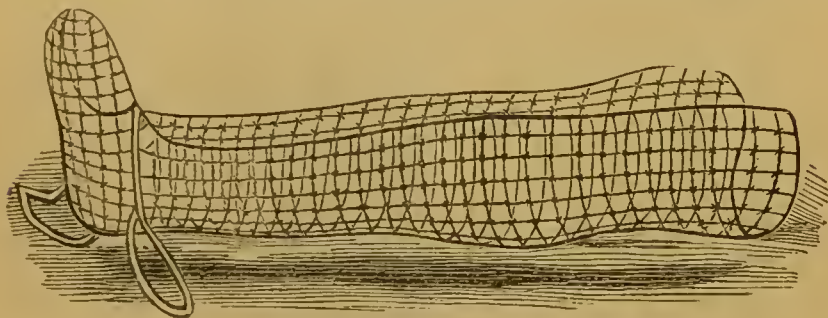


Fig. 41.

moisture of wounds, and have consequently fallen into disfavour; they are, however, in the opinion of the writer, the most valuable and useful splint which a surgeon can take into the field with him, being light and easily adapted to all regions.

Wire or Trough Splints.—The French have introduced splints made of wire, which are very strong, but somewhat cumbersome; they are formed to the shape of the limbs for which they are intended, those for large limbs being composed of a stronger description of wire than those for smaller, and having the general appearance of splint represented in fig. 41, which is intended for the leg.

Wooden and Metal Gauze Splints.—The German army surgeons are provided with strips of thin metal gauze, and thin pieces of wood, but little thicker than veneer, which substances are very light, easily carried, and take up small space in the hospital knapsack.

Duncan Splint.—Duncan has designed a splint known as the “*rattan*

splint:" it is composed of cane or small rattan, strung as it were together and cut to certain lengths; each end is covered with a cap of cloth to prevent splitting or the rough ends irritating. They are very light, but rather bulky, presenting the appearance, without caps, as shown in fig. 42.

A modification of this splint has been made by covering the cane with canvas and attaching three straps and buckles, or as many as may be

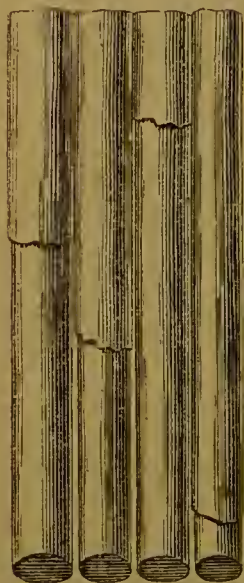


Fig. 42.



Fig. 43.

considered necessary for the size of the splint; this makes the splint more bulky than Duncan's.

Iron wire gauze splints (fig. 43) familiar to all surgeons form most convenient appliances, but are heavy and apt to rust when exposed to moisture.

Wyatt's Splint.—Surgeon-Major Wyatt has designed a splint for field purposes which in appearance resembles an ornamental cover for a flower-pot. It is capable of expanding to a very great extent, and therefore can

be made use of for any limb, no matter how large its circumference may be. He proposes enveloping the fractured limb with it, filling spaces and irregularities with carded oakum, and securing the whole with three straps and buckles (figs. 44 and 45).



Fig. 44.—Wyatt's
Splint folded up.

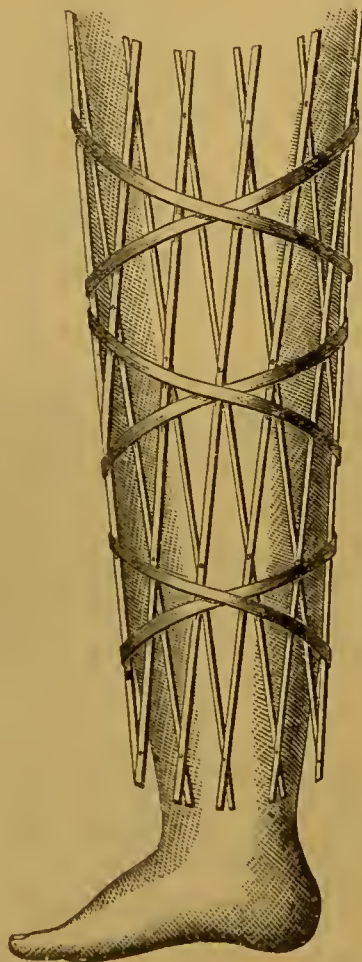


Fig. 45.

Thin sheets of perforated zinc, or tin, gutta percha, leather, cane, whale-bone, felt, and various other materials, have been proposed, so important

and necessary is it that some kind of splint should reach the field of battle and be ready for immediate application.

Among some of the most important of these splints are the perforated sheet zinc of Dr. H. Guillery of Brussels; the "zinc tablets" suggested by the Imperial Austrian army-surgeon D. Schön, and recommended by Langenbeek for the immediate immobilisation of gun-shot wounds of the hip-joints; and Dr. D. Ahl's "adaptable porous splints," which are extensively used in the American army.

Extemporised Splints.—Besides the extemporised splints already men-



Fig. 46.



Fig. 47.

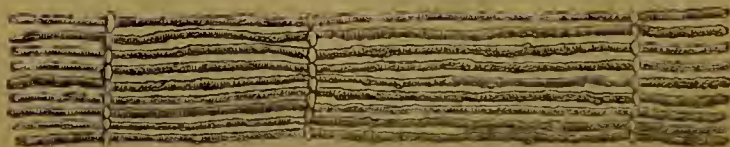


Fig. 48.

tioned, the following articles may be utilised—laths, switches, rushes, reeds, straw, brushwood, twigs (arranged as in figs. 46, 47, and 48), heather, leather straps, such as a trace or stirrup leather, or strips of tin. There is very little difficulty in converting the many articles found about a house, farm-yard, or in fields, into temporary splints, but even with the best and most perfect, which will answer for use in permanent hospitals, there are some fractures in which it is almost impossible to keep the broken ends of the bones in position during transport.

Bark of trees Mr. Benjamin Howard of New York has made use of with great advantage. Telegraph wire has been suggested by the author, the great difficulty with it being a means of cutting it at the exact point required.

This has been obviated by constructing a file on the outside of one of the blades of the straight scissors (fig. 49) in an ordinary pocket-case ; this is capable of cutting a notch in the wire, and so weakening it that it may be

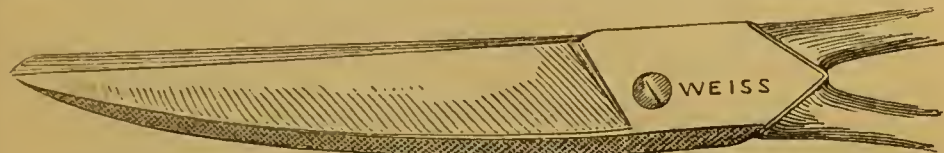


Fig. 49.



Fig. 50.



Fig. 52

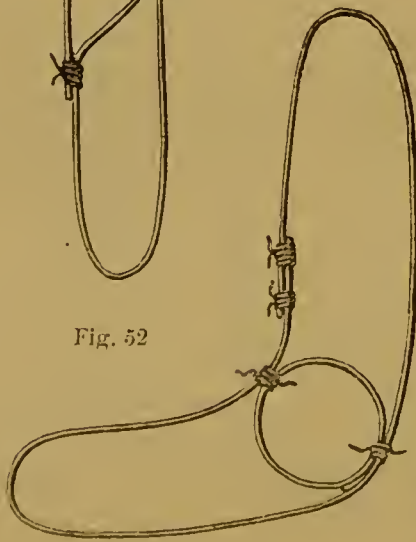


Fig. 53.

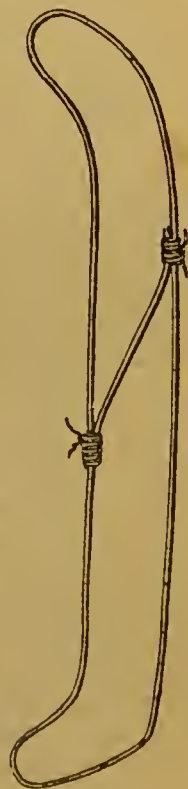


Fig. 51.

broken with ease. Fig. 50 represents a splint for a leg or forearm ; the latter being considerably shorter and narrower.

Fig. 51 represents a splint for the outer side of the upper arm, one end being bent over the acromion, and the other under the olecranon, as might be done with a piece of leather strap. Fig 52 is an inner or back splint for the upper arm. Fig. 53 represents an angular splint for fractures of the lower end of the humerus, or injury of the elbow. These splints may be made more splint-like by having strips of the soldier's clothing, bandage, or other soft material rolled round them, when they will be found capable of supporting any fractures. For fractures of the thigh it is only necessary to select a larger wire and prolong the splint (fig. 52).

Surgeon-General Gordon records an ingenious adaptation of extemporised wooden splints: "Cotton-wool being placed as a cushion upon the splint, it is then applied, a series of silicate of potash bandages at intervals securing the whole in such a way as to render the divided ends of fractured bones quite immovable. The wound itself is left uncovered by the splints, openings being left in them for the purpose."*

Extemporary Pads and Cushions.—The army surgeon may at times be under difficulties as regards the construction of pads or cushions; they may, however, be made with cotton-wool, tow, oakum, chaff, shavings of cork or horn, cut straw, hair, cut paper, feathers, dried sea-weed, bran, dried leaves, felt, saddle cloths, articles of clothing, saw dust, which latter, if taken from any of the pine species, will be found to contain powerful deodorising qualities.

Plaster of Paris has been much used of late years for securing fractures on the field, and though its preparation causes great delay, still the results have been highly satisfactory. During the operations before Plevna, August 1877, and at Shipka (Russo-Turkish War, 1877, 1878), 950 gypsum bandages were applied in the course of a few days, and it is confidently asserted that in the campaign, thanks to gypsum, the treatment of gun-shot wounds traversing the limbs has been most successful.†

Many plans have been proposed for its application, but the surgeon should make himself familiar with its nature and its preparation before attempting to apply it on the battlefield.

Billroth remarks on this subject: "I consider the treatment of gun-shot fractures by fenestrated plaster-bandages as the only proper method (excepting perhaps those in the upper part of the arm or thigh); the only thing against it is that surgeons who have not already treated open fractures with plaster dressings, and are not adepts in the application, should not make their first experiments on gun-shot fractures, but should only apply dressings with which they are familiar."

Pirogoff, who claims priority of the invention, gives the following account of the process for its application: "A drainage tube is drawn through the wound, which is either covered with charpie or united by sutures, a roller

* "Lessons in Hygiene and Surgery," by Surgeon-General Gordon, p. 128.

† Russian medical journal, "Sooraymenaya Meditsina."

of flannel, cotton, or other rough texture is applied over the entire limb, and on this the plaster of Paris is smeared ; a large piece of wire gauze is then taken, an aperture corresponding to the size and position of the wound cut out, and with the remainder the limb is closely enveloped. Plaster of Paris paste is again laid on, and finally the whole is fixed by one or more layers of paste bandage, additional turns being given in the vicinity of the fenestra, if extra strength is required. When the material has fully hardened, the fenestra is opened through the parted bandage by means of a strong scalpel. The plaster of Paris bandage may be put on either at the bandage-place preparatory to transport, or subsequently in the hospital for the purpose of treatment ; in the former case without fenestra, providing the distance to be accomplished is not too great, and that the appliance can be removed on arrival. Pirogoff does not delay its application on account of inflammatory swelling, but he slits the bandage up the whole length, and so converts it into a case out of which the limb can be taken and cleaned when required. When the swelling subsides, the ordinary plaster of Paris bandage must be substituted. He lays down the fundamental advantages of the appliance as follows :—

“ It exercises a uniform circular pressure throughout the entire length of the limb, thereby paralyzing the attacked muscles ; it secures immobility to the broken fragments ; and it keeps up continuous extension to a certain extent when put on and allowed to harden while the limb is extended. The firm unyielding capsule formed by this bandage when it embraces the joints above and below the wound prevents the further approximation or riding of the broken ends, and keeps the limb on the constant stretch. Finally, the fenestra in the bandage must be so arranged that the fixity of the bandage must not be lessened.”*

Surgeon-Major Moffitt, who has made several experiments in connection with the employment of plaster of Paris as a means of forming splints or supports to facilitate the transport of men suffering from gun-shot fractures, recommends the following mode of application :—

“ Plaster of Paris in a proper state, water, spermaceti ointment, a small basin and a spoon, being in readiness, a piece of flannel is to be cut, of shape and size fitted to envelope the limb, with the exception of a longitudinal space, of about half an inch in breadth, between its edges. If for the leg, it should be of the shape shown by the dotted line in the illustration (fig. 54).

“ The limb should then be greased with spermaceti ointment, and the hairs smoothed down to the skin, or, what will be found to answer as well, if not better, a calico roller may be wound spirally round the limb, and divided at a later period, after the plaster covering is applied, along the vacant interval between its edges. The calico will not only prevent the hairs from sticking to the plaster, but will also form a neat lining for the splint. Either

* “ Medical Times and Gazette,” August, 1873.

of these steps having been taken, equal parts of plaster of Paris and water should be quickly and thoroughly blended together by stirring, and in this mixture should be immersed, with the hands, the piece of flannel about to be used. When the flannel is well saturated, and its surface completely covered with plaster, it should be withdrawn from the basin, the folds and

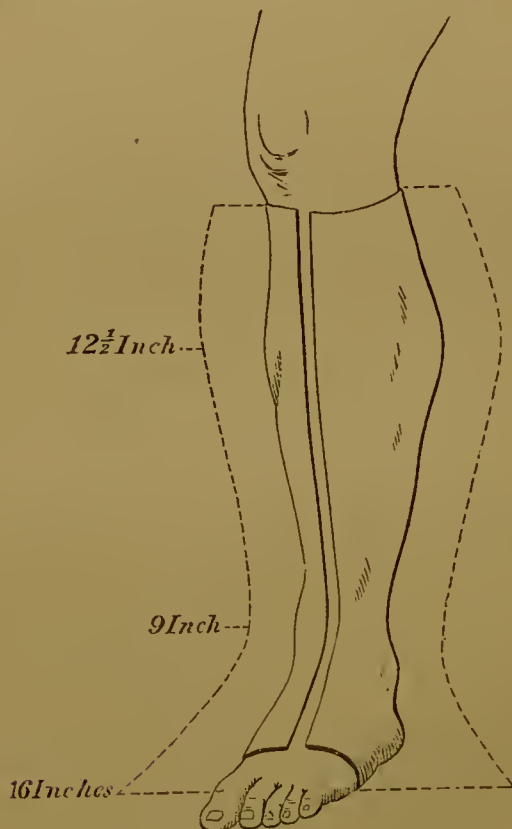


Fig. 54.

creases stretched out of it, and it should then be applied and pressed to the limb so as to fit it accurately, without, however, permitting its edges to join each other; the object of this last precaution being to leave a narrow open space up the whole length of the limb, to allow for the occurrence of swelling. In this position it should be held steadily until the plaster has set,

which will generally not occupy longer than five minutes. The illustration shows the splint applied to the leg. Should the splint, however, after the plaster is set, be considered not to have strength and firmness enough, another layer may be applied over it exactly in the same way. A roller may now be applied lightly over the whole.

“The quantity of plaster requisite for a leg is about eight ounces ; for the thigh and arm in proportion.

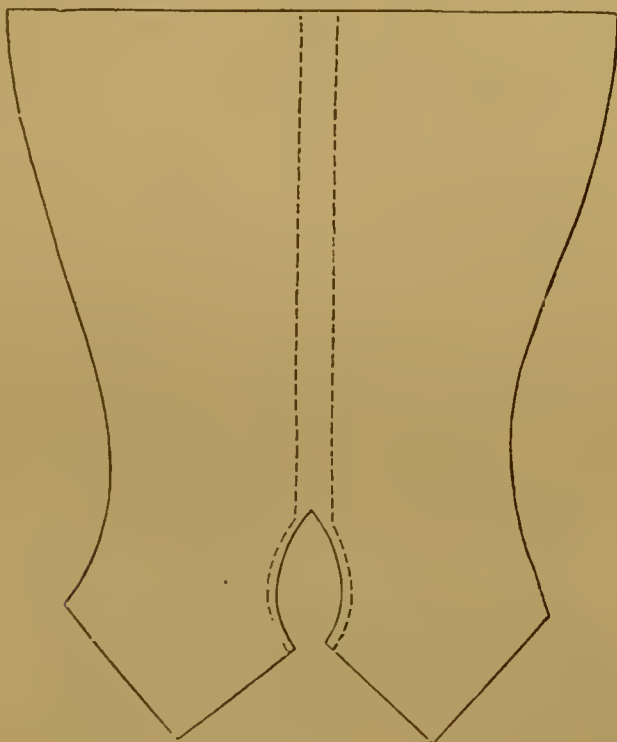


Fig. 55.

“Should it be desired, however, to make the plaster more secure, or to continue its application as a permanent splint, this may be done with great facility by the addition of a little dextrine. This will be best accomplished by taking a piece of flannel of the dimensions similar to that used for the plaster of Paris, coating one side of it over with a thick solution or paste made with the ordinary dextrine, and applying it over the plaster of Paris splint already in use.”

Neudörfer recommends a very simple plan for the application of plaster of Paris bandages : "Compresses of linen or of lint are dipped in the plaster of Paris of the consistence of a common poultice. These are then placed longitudinally on the limb, first on the upper, then on the under part. A few turns of a bandage keep them *in situ* till the plaster is set. To prevent the contiguous edges adhering, they are lightly greased, or a slip of greased lint is put between them."

At the Congress of Military Surgeons held in Paris, 1878, *Neudörfer* exhibited another method. He encloses dry plaster between folds of cotton or linen cloth, this he thoroughly saturates with water, which he presses out by passing a piece of stick rapidly and evenly over the surface of the cloth. This description of bandage dries quickly.

The mode of applying the plaster apparatus, as practised in the *Bavarian Army* during the late Franco-German war, is as follows : "Two pieces of flannel, 20 inches broad, are stretched together for the leg, as represented in fig. 55, and stitched down the middle ; and beyond this both are cut through in the same line for the length of the foot. The flannel is placed under the limb, so that the seam reaches from the ham to the heel. The sides of the inner piece are brought together over the leg and fixed in front and along the sole by pins (bent at right angles, fig. 56, so that they may

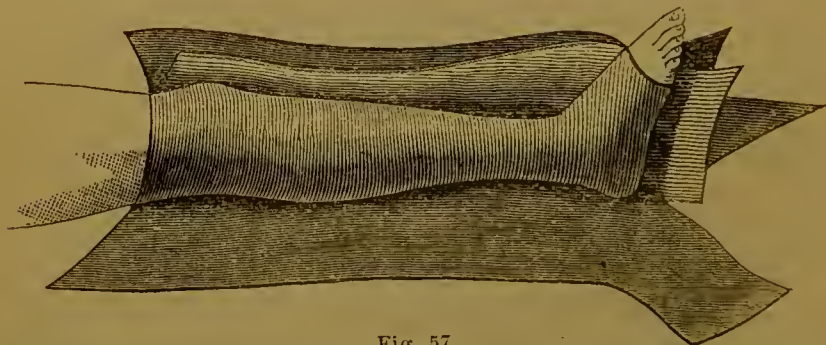


Fig. 57.

be easily extracted afterwards), and thus a closely fitting stocking is formed. The sides of the outer piece are then brought forward and cut, so that each may overlap the middle line of the leg and sole by three-quarters of an inch. The limb is then laid on one side, and while this outer piece of flannel is held back, a layer of plaster of Paris of the consistence of thick

cream is spread evenly to the thickness of half an inch over the inner piece, and made to pass quite to the seam behind and the line of juncture of the sides of the inner piece in front. The outer piece is pressed over this before it sets, and should just reach the middle line in front and along the sole. When this has set, the limb is turned over, and the process is repeated on the other side (fig. 57). The pins may now be removed. The seam serves as a hinge; and when the whole has set, the splint may be taken off, the edges of the plaster trimmed, and those of the inner piece of flannel cut so as to leave sufficient to turn over and stitch down on the outer piece. The splint is then readjusted and fixed by a bandage. The setting of the plaster may be retarded by the addition to it of solution of borax. Thus a solution of one part to twelve of the water used will retard the setting fifteen minutes.

From experiments made at Netley, the following are the quantities of plaster of Paris required for each of the different bandages by the Bavarian method,—leg, 24 oz.; thigh, 28 oz.; elbow and forearm, 16 oz.

Volcer has devised a plan for applying a plaster of Paris bandage to a

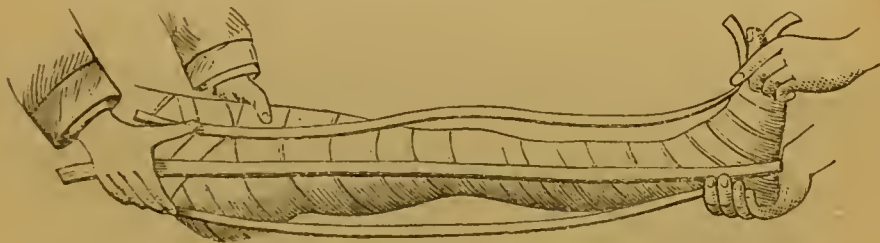


Fig. 58.

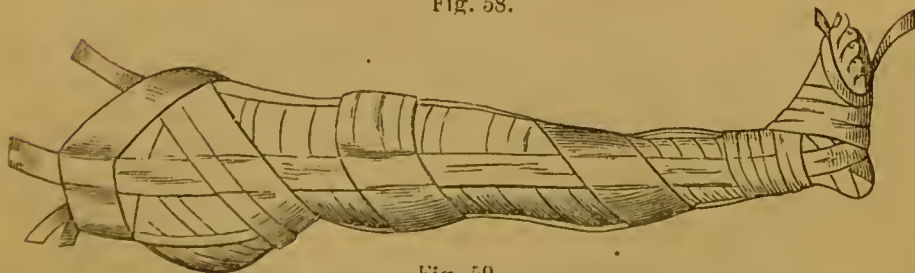


Fig. 59.

fractured thigh, which is as follows:—If time admits, give chloroform and keep the patient under its influence till the plaster hardens. The patient should be kept perfectly steady. The extremities, from the toes to the haunch, must be enveloped in wadding, which is to be cut into strips 4 inches in width; this wadding is then to be covered with moist gauze, which keeps it in position; over this narrow strips of thin wood (fig. 58), so

flexible that they can be rolled like a bandage, are to be placed on four sides of the entire length of the limb. Two attendants fix with their hands these long splints until an ordinary plaster bandage, which has been dipped in water, has been placed round the limb, by means of which the splints are firmly fixed (fig. 59). Then five or six plaster bandages are used from the

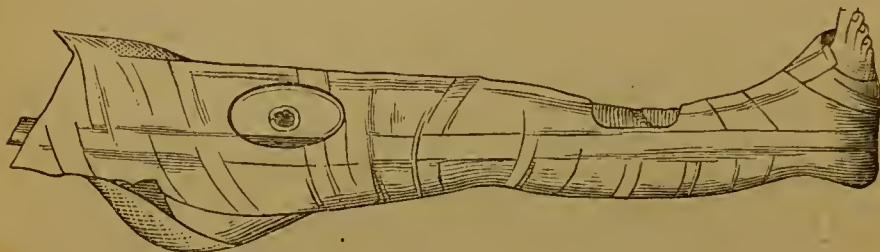


Fig. 60.

toes to the haunches, carrying the bandage well round the hips. Care should be taken that the plaster bandage does not extend over the wadding at the hips and abdomen, and that an orifice (fig. 60) is left for discharges and application of dressings in the event of there being a wound.

Swinburne's Stretcher (Brancard).—Surgeon-General Gordon describes a contrivance for the carriage of a soldier suffering from fracture of the thigh,

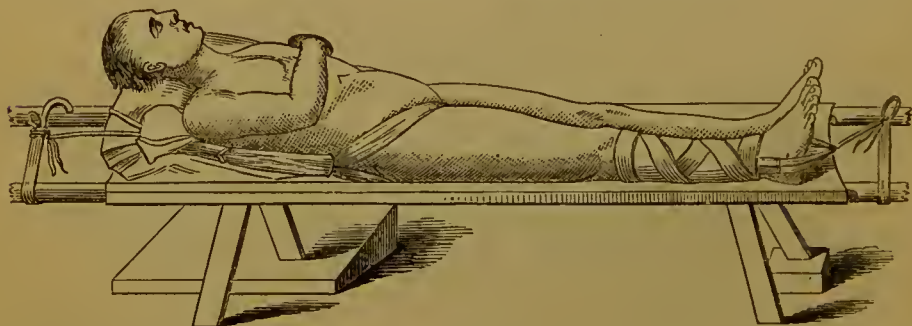


Fig. 61.

which has been designed by Dr. Swinburne. By means of a common stretcher or brancard, ingeniously arranged, Dr. Swinburne considers that a soldier or officer with gun-shot fracture of the femur can be carried with an advancing army over any extent of country. Upon one of the handles at each end a bent iron arm, having an "eye" at one end, is fixed by means

of a screw, and admitting of being moved along the handle, or from one to the other, according to the seat or side of the injury. From those at the head and foot, extension and counter extension can thus readily be used, as represented in fig. 61.* This plan (as represented in the illustration) might answer for a very short distance over a level country, but without further support to the broken bone it is doubtful whether it would answer as a mode of transport for any considerable distance.

Appia's Apparatus.—Dr. P. L. Appia, impressed with the danger to reunion of bone from transport under disadvantageous circumstances, invented and had made, that it might be tried in the war in Italy, an apparatus for fractures, which he describes as follows :—

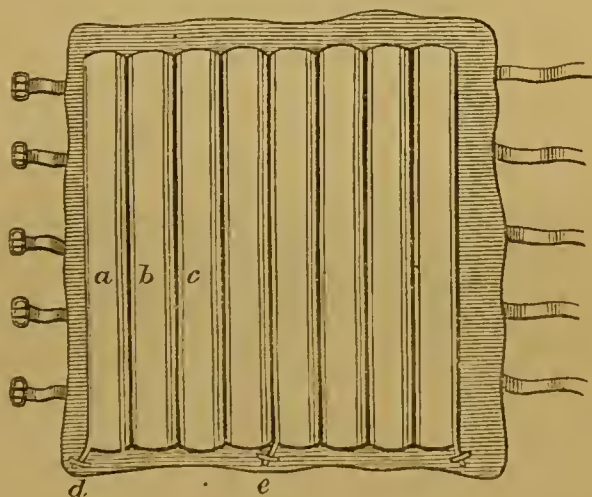


Fig. 62.

"After having been tried in the army of Italy, this apparatus was introduced into the military hospitals of Paris and Turin, and into the Spanish army. It consists of a number of splints and vulcanized india-rubber air cushions (fig. 62, *a*, *b*, *c*). The cushions are joined together and form one whole. At the extreme end of each cushion, or pair of cushions, there is a plug for inflating it (*d*, *e*). The splints, to the number of five, are bound in strong canvas, which serves as a covering to the cushion (fig. 63). I preferred five splints to three, the usual number, that it may entirely surround the limb, and thus ensure more entire immobility during the removal. The apparatus varies in size and number of cushions. In the simplest there are

* "Lessons in Hygiene and Surgery," by Dr. Gordon, C.B., p. 89.

four cushions, about 50 centimetres in length to 15 in breadth, inflated by two plugs, and five splints of the smallest size, with three straps. This very simple form is intended *especially* for wounds of the knee, the leg, and the foot.

"The other more complicated apparatus, which I am about to describe, was the object of my most careful study. It is intended for fractures of the

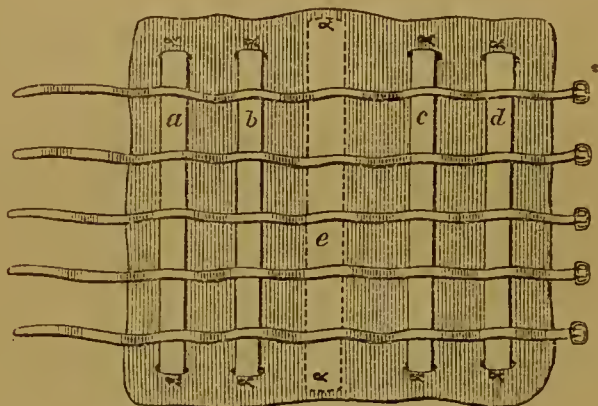


Fig. 63.

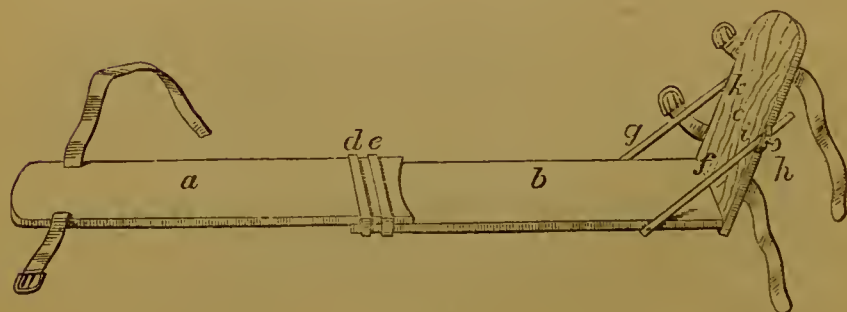


Fig. 64.

thigh, and for complicated wounds of the knee. Here the cushions must be six or eight in number, longer and narrower than the former, 70 centimetres in length to 6 in breadth; they may be inflated by either of the plugs. There are five straps. But what particularly distinguishes this apparatus from the other is the long splint (fig. 64). It is composed of several pieces

intended to admit of its extension, and yet form as firm a support as if they were all one piece of wood.

"The splint is composed of two half-splints and of a sole for the support of the foot (*a, b, c*); the two halves, joined together by two smooth brass rings, can slide over each other without losing their respective directions.

"Upon the back of one of the boards is a series of notches (*encoches à crémaillère*) (fig. 65, *a, b, c*), into which fastens a spring or hook, fixed at the end of the other board. A very simple mechanism thus admits of firm and gradual lengthening, both being effected by simply drawing out the splint.



Fig. 65.

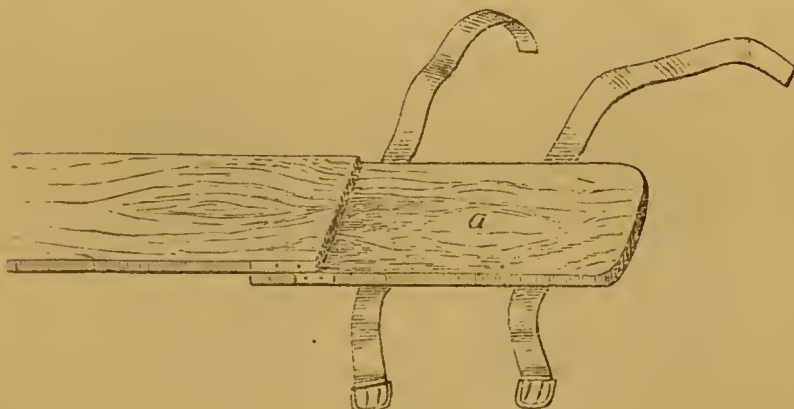


Fig. 66.

"The foot-piece is fastened to the lower board by means of a lateral hinge, which, being firmer than an ordinary one, allows at the same time of the sole being brought down entirely (fig. 66, *a*). Two brass supports, fixed laterally (fig. 64, *g, h*), can then be detached, go into two openings formed by a metal plate, and slide into it without difficulty (*i, k*); they are stopped by a screw. The sole is, besides, furnished with canvas straps, intended to keep the foot firm, which are buckled to the lower surface of the boards, so as to avoid all painful pressure of the foot. A long stirrup, placed at the upper end of the splint, fastens it to the body. When this apparatus has

been used, it is easy to shorten the long splint by folding it up to the exact size of the other simple splints, save in the thickness, which must necessarily be double (fig. 67).

“The following is the manner of its application on a healthy body supposed



Fig. 67.

to be wounded in one of the thighs :—1. The person is laid in the horizontal position. 2. The dressing is quickly opened, and spread out smoothly by the side of the thigh supposed to be wounded. 3. The long splint is drawn out in both directions to its utmost length without withdrawing it from the



Fig. 68.



Fig. 69.

canvas sheath in which it is enclosed. 4. The wooden sole is lowered horizontally. 5. The whole apparatus is passed under the injured limb, so that the sole may be properly fitted to the foot, which is firmly fastened by means of the leather strap. 6. The upper end of the splint is fastened to the pelvis by the long strap. 7. After the long splint has been thus firmly

applied to the limb, the assistant must stoop down and inflate the cushions successively by the plugs. This requires strength and some degree of perseverance. 8. The whole apparatus is thus drawn completely round the limb, taking care that the cushions meet in front, and all firmly fastened together by five straps; in doing so making use of the support of the left knee. This is the time when the buckles are put to the test. 9. Finally, the sound limb is firmly fastened to the wounded one. Experience has, curiously enough, proved how entirely the leg is secured in this apparatus from any shocks from without. One may even sit down upon it violently, when fixed and buckled up, without the leg experiencing anything beyond a slight increase of pressure. All shocks from without spread immediately, by the law of undulation, through all the cushions, and produce only a trifling direct effect."

Arm Slings.—The most convenient form of sling for supporting an injured arm is the triangular bandage already referred to (fig. 24); but, in the event of one not being available, the skirt of an infantry soldier's tunic may be slit up at the side and secured by a pin, as shown in fig. 68. The skirt of the artillery and cavalry soldier's tunic being much shorter, the sleeve of the injured side may be utilised by being slit up and secured as represented in fig. 69.

WOUNDS.

Wounds, how inflicted.—Wounds inflicted in war may be produced by missiles projected by some explosive material, such as bullets, cannon shot, shrapnel, shells, grape and cannister shot, and slugs, which come under the head of gun-shot wounds. There are other wounds produced by sabre, bayonet, or lance, and indirectly by fragments of substances struck by bullets, shot, or shell—such as stones, wood, metal, and even by fragments of the bones of comrades, or by explosion of the engines of war above and below water. Arrow wounds are occasionally met with.

Nature of Wounds.—From the depth to which wounds extend they are denominated *superficial*, *muscular*, and *penetrating*: and from the nature of the weapon with which they have been inflicted they are characterised as *incised*, *punctured*, *lacerated*, and *contused*. They may also be classified according to the region of the body, as, for instance, *wounds of the head*, *face*, *neck*, *thorax*, *abdomen*, and *extremities*.

Treatment of Wounds.—As regards the treatment of wounds, they must first be considered under the head of incised, punctured, lacerated, and contused wounds of soft parts, and then in connection with regions.

Incised wounds, or such as may be produced by sword or sabre, should be carefully cleansed, all extraneous substances removed, the edges brought together, and, if necessary, kept in position with adhesive plaster or sutures.

And to assist in preventing the wound opening, the muscles in connection with the parts injured should be relaxed by regulating the position of the limb. The parts must be lightly dressed with lint or charpie, and kept in position with a roller.

Punctured wounds (such as may be produced by a bayonet) of the soft parts are peculiarly liable to excite inflammation in the neighbouring textures; to promote the formation and confinement of matter under the fascia; to cause injury of deep-seated vessels and consequent hæmorrhage; and to induce tetanus by lesion of a nerve.

Older surgeons were in the habit of forcibly dilating punctured wounds with a view to preventing the unpleasant consequences mentioned, being fully aware of the danger of these wounds. There is little doubt that they did not improve the condition of their patients. An improvement was then made of dilating them with the knife, and so converting them into simple incisions; but this expedient has been also abandoned, as it does not follow that inflammation or suppuration will as a necessity supervene. The practice now advocated is to keep the parts at perfect rest, and apply a roller to the limb to prevent subcutaneous oozing of blood. Pressure *should not be applied immediately over the wound*, but free exit allowed for any discharge. Should a foreign body be discovered, it may be removed, but probing in search of extraneous matter is inadmissible. In strong, healthy soldiers, when inflammation runs high, it may be necessary to place them on low diet, antimonials and purgatives. Evaporating lotions are to be applied to the affected parts, and in the event of suppuration taking place, the case must be treated as a deep-seated abscess, a free incision being made to evacuate the pus.

Lacerated wounds are such as are inflicted by blunt obtuse bodies destroying to a certain extent the vitality and organization of the textures. There is usually little hæmorrhage, but the pain may be very severe. If the wound has been from the effects of a cannon shot, the parts will present a very ragged surface, the skin being stripped away, the tendons in all probability hanging out, bellies of torn muscles protruding, and the vessels exposed; but no hæmorrhage. These wounds are very slow in healing, in consequence of the superficial parts being disorganized; sloughing must first take place, after which the wound will heal by granulation. These wounds are particularly liable to traumatic gangrene, and in the head to erysipelas.

The parts should be carefully cleansed, and foreign bodies removed. Flaps of skin, however torn or contused, should, as a general rule, never be separated, provided they maintain any attachment to the neighbouring tissues, but be replaced in hopes that vitality is not virtually destroyed.

In simple cases of lacerated wounds, the separation of the slough must be facilitated by the application of poultices, or, what will be found most convenient on service and cleanest, simple water dressings. Disinfectants must

be freely used on the wound and in the neighbourhood of the patient's bed, as it is from these wounds, when many of them are collected together, that hospital diseases arise.

Contused Wounds.—These may be simple, requiring some evaporating lotion or stimulating liniment, and a few days' rest, to restore the injured parts to their normal condition; or the parts may be so damaged that sloughing takes place, when the injury should be treated on the same principles as in sloughing from lacerated wounds.

Wind-Balls.—Extensive injuries to internal viscera have been inflicted without any sign of an external lesion; bones have been broken, and yet no sign on the external skin of contact with any missile. These injuries are produced by what are known as wind-balls, which many authorities on gun-shot wounds have endeavoured to explain. Some consider they are produced by aerial percussion, from the mass of metal being projected through the air with great velocity; others attribute it to electricity.

Mr Longmore considers that "the true explanation of the appearance presented in those cases which were formerly called wind contusions, appears to rest in the peculiar direction, the degree of obliquity with which the missile has happened to impinge against the elastic skin, together with the relative situation of the internal organ injured to the missile and to other hard substances in the neighbourhood. The surface itself is not directly torn or cut into, because the impact of the projectile has not been sufficiently direct to effect an opening; but the parts beneath are crushed by the pressure to which they have been subjected between the combined influence of the weight and the momentum of the ball or shot on one side and of some hard resisting substance on the other. Thus, on a cannon ball passing across the abdomen, the elasticity and ready mobility of the skin may enable that structure to yield to the strain to which it is exposed, while viscera are ruptured by the projectile forcing them against the vertebral column. So the weight of a ball passing obliquely over the fore-arm, may possibly crush the bone between itself and some hard substance against which the arm may be accidentally resting, without lesion of the interposed skin."

Wounds, whether received directly or indirectly, may be complicated by the entrance of extraneous bodies, such as portions of clothing worn by the wounded, or various articles which may have been about his person.

GUN-SHOT WOUNDS.

How Gun-shot Wounds are Influenced.—Gun-shot wounds may be influenced by the shape and weight of the missile, its velocity, and the structure injured. For instance, a conical bullet will do more injury to a bone and soft parts than a round one of the same weight and fired at the same proportionate distance; and a hollow conical bullet will cause more damage to the

soft parts, periosteum, and bone, than a solid, both being fired under the same circumstances. The position a limb may be in at the time of being struck will influence the direction of the wound ; also a very slight obstacle, such as a button, or a coin ; and even a tendon in a state of tension has been known to turn the course of a *round bullet* ; this is scarcely possible with the conical bullet fired at a short distance, which has such force as to pass directly through a limb, smashing all before it.

Examination of Wounds.—It is of the greatest importance that strict cleanliness should be observed in the examination of wounds, as on the battlefield the surgeon may inadvertently poison wounds by conveying blood and other matters on his hands ; even constitutional syphilis may be transmitted in this way.

Penetrating gun-shot wounds of extremities should be examined most carefully for bullets, fragments of shells, or other extraneous bodies ; and for doing this the finger will be found the most convenient and least likely to give pain ; it will also most readily detect the nature of a foreign body.

The sooner this operation can be performed the better, as the wound will contract and surrounding parts inflame ; so that the longer a search is delayed, the greater the suffering to the soldier, and the more difficult the operation ; in fact, wounds should not be explored when in a high state of inflammation.

The finger may not be sufficiently long to reach a bullet or other foreign body, or the wound may be too small to admit the finger, in which case a silver probe should be used, or any other probe which the surgeon may consider best suited to the circumstances of the case ; but until the finger fails, no other probe should be used. On this point, Hunter remarks : “ Probes should never be used but by way of satisfaction in knowing sometimes what mischief is done ; we can perhaps feel if a bone is touched, or a ball is near ; but when all this is known, it is an hundred to one if we can vary our practice in consequence of it. If the wound will admit of it, the finger is the best instrument ; but if the wound is too small, it may be enlarged by an incision through the fascia.”

In exploring for bullets, various plans have been devised. In olden time the wounded man was actually lifted and placed in the same position he was supposed to have been in when wounded ; but the educated surgeon can now picture to himself that position, and cause the finger or probe to work accordingly, without altering the position of the sufferer.

Mr Longmore recommends the following course to be adopted when exploring with the finger :—

“ The finger should be inserted slowly and steadily towards the deepest part of the wound. During its passage, the surgeon should carefully observe whether any foreign body appears to be pushed before it, or to be lying by the side of the track of the bullet, and should note any other

peculiarities of the wound. He should also ascertain whether the end of the track is reached, and if this is found to be arrived at, a careful circular sweep of the finger-end will then usually settle if any, and what, foreign bodies are lodged. The surgeon should not withdraw his finger until the course the projectile has taken, the injury it has done, the complications of the wound, such as the presence of foreign bodies, and, in such a case, their kind and situation, have been decided by him; the exploration will then be completed by one operation, and a second insertion of the finger for the purpose, which is always irritating to the patient, avoided. If the finger be not sufficiently long to reach the bottom of the wound, even when the soft parts have been approximated by pressure from an opposite direction; and when the lodgment of a projectile is still suspected, or some other point of doubt remains to be solved, such as the direction the projectile has taken in the latter part of its course, we are compelled to make a further exploration by other means. Generally, a long silver probe, that can be bent if required, and that can be guided into a definite direction at the will of the surgeon, will be found to be the best substitute for the finger. The probe should be used with great discretion, for, without care, it may readily be made to inflict injury on vessels and other structures which have escaped from direct contact with the ball, but have returned by their elasticity to the situation from which they had been pushed or drawn aside during its passage.

"Sometimes, when the finger in the wound fails to find a lodged projectile, the particular spot in which it is lying may be detected simply by relaxing the muscular tissues, so as to give a loose and pendulous condition to the parts concerned, and then lightly tossing up the flesh at different points from below with the tips of the fingers. A bullet lodged among the soft parts will occasionally make its presence known under such an action by the impulse which its weight communicates to the top of one of the fingers when the parts, having been shaken upwards, return to their previous position. Sometimes a gentle kneading pressure in the neighbourhood of the injury, assisted by information derived from the sensation of the patient, will lead to the detection of such a foreign body; or it may be discovered by passing the palm of the hand down a limb.

"Cases in which the exploration by the surgeon's finger is altogether impracticable, and in which the use of the probe is attended with so many sources of doubt as to prevent any satisfactory conclusion in respect to the lodgment or absence of foreign bodies from being arrived at, occasionally occur." Much trouble and inconvenience will then be experienced unless the surgeon is in possession of some of the new contrivances for clearing up these doubts.

Nélaton's Probe.—M. Nélaton designed a probe for ascertaining the nature of the foreign body impacted in the bone of one of General Garibaldi's



Fig. 70.



Fig. 71.

ankles. It consists of a slender rod of metal 5 or 6 inches in length, terminated at one end by a small knob of white, unglazed biscuit china. The other end of the probe is furnished with a small handle, grooved ridge-and-furrow fashion, in order that the finger and thumb may the more easily roll it between them, while the porcelain knob is being pressed at the bottom of the wound against the suspected foreign body (fig. 70). If it be a leaden bullet against which the porcelain is rubbed, a very distinct mark of lead is impressed on the latter, which is not easily obliterated.

This probe of M. Nélaton's may possibly deceive the surgeon, if he supposes, because no dark mark has been produced on the biscuit china, that consequently there is no bullet, as in the event of there being anything—such as pieces of cloth, paper, linen, membrane—between it and the probe, there will be no leaden mark.

Lecomte's Probe.—Dr. Lecomte has designed an instrument (fig. 71) with a view to obviate the difficulties experienced with Nélaton's probe, which not only indicates the presence of lead, but by bringing away a small portion of anything capable of being cut into, declares what it is. He has given it the name of the "Probe Nippers" ("Stylet Pince"). It consists of two fine steel blades enclosed in a canula; each blade terminates in a little cup, and when both are brought together they form a small knob. These blades are in connection with a rod and handle worked by a screw. When the knob of the probe is brought into contact with the extraneous substance, it is caused to open, and then, by pressure against it and causing the little blades to close, a small portion is carried away. Several instruments have been designed for detecting lead and other metallic substances by means of electricity.

Taylor's Explorer.—Mr. Taylor's electric explorer consists of two insulated needles. They are connected by wires with a small galvanic battery and mariner's compass. When the points of the needles touch the metallic substance the needle of the compass is deflected.

De Wilde's Explorer.—Mr. De Wilde has adapted a telegraph bell to the electric apparatus, which denotes the presence of metal by the sounding of the bell.

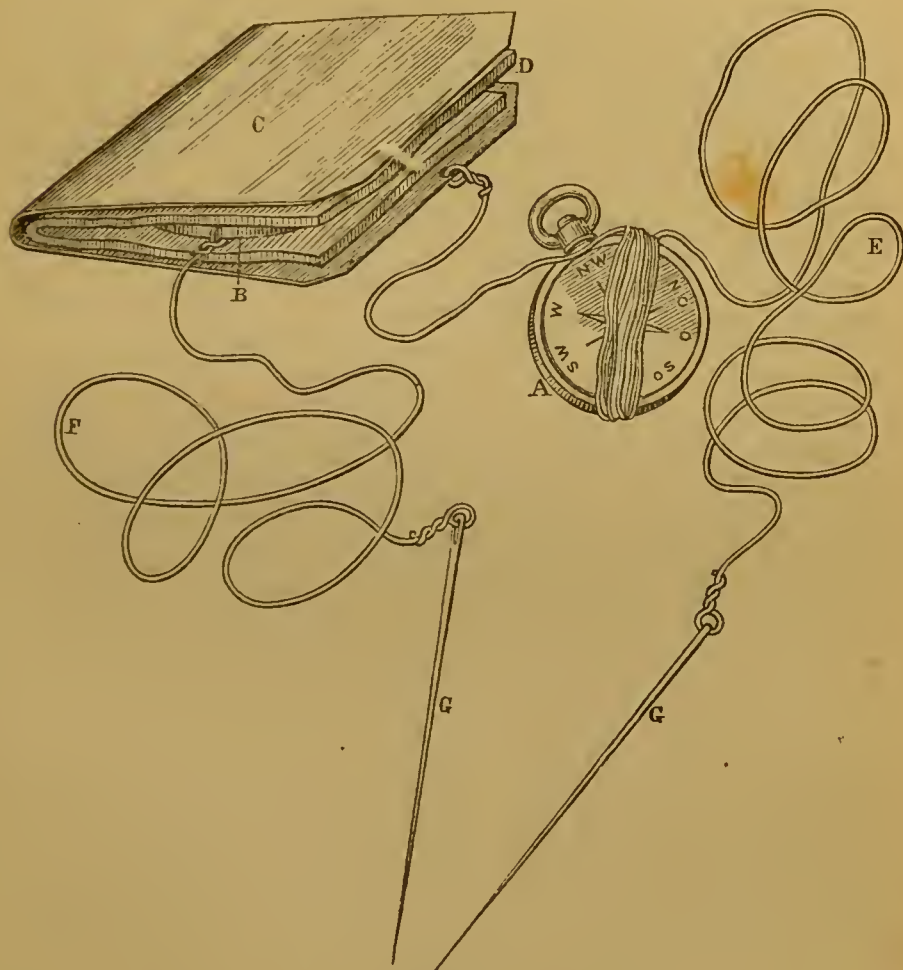


Fig. 72.

A, Pocket compass; B, Copper sheeting (a penny piece will answer); C, Plate of zinc; D, Flannel saturated with dilute acid; E and F, Insulated wires; G, Exploring needles.

Liebreich's Explorer.—Liebreich has designed an instrument somewhat similar to Tailor's, except that a galvanometer is substituted for the mariner's

compass, the needle of which is deflected on the electric circle being completed.

Professor Longmore exhibits to his class (R. V. Hospital, Netley) an easily made electric instrument (fig 72), so portable that it can be carried about the person of the surgeon. He describes it as follows:—The magnet of an ordinary pocket compass, which has had some turns of wire covered with thread wound round it as an induction coil, is employed for the electric indicator, while a piece of zinc sheeting bent round a small plate of copper, but separated from it by flannel padding saturated with the usual diluted acids, forms the voltaic pile. The exploring instrument is formed by two insulated wires bound together, but the points left free. These parts being connected, when the circuit is completed by contact with metal, the indication is given by movement of the magnet of the compass.

Endoscopic Exploration.—Dr. Fenger of Copenhagen has suggested the use of the endoscope in exploring for bullets and foreign bodies. He says that during the late Franco-German war he was enabled in several instances to see the interior of wounds without causing inconvenience.

The Microphone invented by Professor Hughes, when further developed, will doubtless become a great aid in detecting foreign bodies in wounds.

Detection of Lead and Iron.—In 1872 M. Desneux suggested that in wounds having an obscure and curved course, and where the missile cannot be readily felt by the probe, that the wound should first be thoroughly cleansed with pure water by means of a syringe, after which a solution of nitric acid (5 to 15 drops to a drachm of distilled water) is to be injected into the wound and allowed to remain a sufficient time to come in contact with and dissolve a portion of the ball. The injected fluid is then withdrawn, either by syringe or by changing the position of the patient so as to let it run out in two portions. One of these is to be tested with iodide of potassium, when, if lead be present, the well-known yellow colour will be obtained. To the other is added a solution of sulpho-cyanide of potassium, which will turn red if iron be present; or ferro-cyanide of potassium, which will give a blue colour.

Extraction of Bullets and other Missiles.—For the extraction of bullets, fragments of shells, or other extraneous matters, various instruments have been devised. Coxeter's extractor has been found most useful for this purpose. Also a long and strong forceps with spoon-like blades, into which a bullet is supposed to slip. There is also the "tire-fond screw," and Liers' sharp-pointed forceps; and innumerable forceps designed to suit the fancies of military surgeons. Billroth speaks in favour of the American bullet forceps, its peculiarity being that it can be well opened even in the narrowest canals, and that it catches securely; he finds himself that long strong ear or nose-forceps and polypus forceps are the best. None of these can be applied without careful manipulation by the surgeon, who with his finger may be able to direct the end of the forceps towards the lodged

missile, or with the hand on the outside of the limb press the bullet towards the instrument.

If the wound is not very deep, the finger (especially the little one) introduced into it may, assisted by some manipulation, hook the missile with the first joint and so extract it, the wound being slightly enlarged ; such a case has occurred in the author's own practice.

Bullets found near the skin, which have not had sufficient force to make an exit, require much care in removing, especially in the neighbourhood of a cavity, as by injudicious handling they may be pressed back into the cavity. It is therefore always best to fix the substance to be removed before using the knife, the incision made being free.

Bullets lodged in bone, which frequently happens in the spongy ends of some without causing fracture, should be cut down upon and removed. If superficially lodged, the steel elevator will be found best suited for the purpose ; or if a leaden bullet is deeply impacted, the tire-fond screw already alluded to will be found convenient, or Luers' sharp-pointed bullet forceps, which is so formed as to work into the lead and take a firm hold.

In all cases of lodgment, where extraction is attempted, care must be taken not to injure the great vessels and nerves, to cause much irritation to the soft parts by extensive incisions, or to use violence.

Gun-shot Wounds of Muscular Parts.—These wounds may be divided into four :—(1) Where the missile causes no wound, but simply a contusion of the soft parts ; (2) where the missile does not enter the soft parts deeply, but carries away a portion of the skin ; (3) where the missile perforates the skin and does not escape (into this various other bodies may be carried, such as portions of uniform, pieces of cloth, buttons, pieces of leather, bone, &c.) ; (4) where the bullet enters at one point, and escapes at another. Gun-shot wounds of muscular parts become painful, swell, and the usual symptoms of inflammation set in from twelve to twenty-four hours. The neighbourhood of a wound in a limb may become discoloured, depending on the amount of contusion and severity of the injury.

The discharge from a gun-shot wound is at first a reddish fluid ; after a day or so it becomes darker and thicker ; but much will depend on the amount of sloughing likely to take place, as if the parts are much bruised or burnt, which latter condition sometimes occurs from close shots, the character of the discharge will be modified, and separation of the dead from the living will be longer delayed. Following the separation, there will be discharge of purulent matter, which gradually diminishes. As the wound fills with granulation, this discharge may continue for an indefinite period, in consequence of retention in the wound of some foreign body, such as a piece of clothing or a splinter. It is therefore necessary at each dressing to make a most careful inspection of the wound, and remove anything which the introduction of a probe will probably detect.

Hunter remarks on gun-shot wounds, that "from the circumstance of commonly having a part killed, in general they do not inflame so readily as those from other accidents; this backwardness to inflame will be in the proportion that the quantity of deadened parts bears to the extent of the wound; from which circumstance the inflammation is later in coming on, more especially when a ball passes through a fleshy part with great velocity, because there will be a great deal deadened in proportion to the size of the wound; therefore, inflammation in gun-shot wounds is less than in wounds in general, when the same quantity of mischief has been done; and this also is in an inverse proportion to the quantity of the parts deadened. According to the velocity of the ball, so is the direction. When the velocity is great, the direction of the ball will be in general more in a straight line than when it is small. Velocity in a ball makes parts less capable of healing than when it moves with small velocity; therefore, gun-shot wounds in pretty thick parts are in general later of healing at the orifice where the ball enters than at the orifice where it passes out; if, therefore, the wound of exit is in a depending position, it may be necessary to keep it open by artificial means."

Wounds not having a free exit for discharge, very frequently burrow and give much trouble, more particularly if there be lodgment of an extraneous body. The following case will illustrate this. During the siege of Sevastopol, a brother officer of the writer's, when returning from duty in the trenches, experienced a severe lacerated wound in the anterior part of the left thigh, which he stated was caused by a shell exploding in front of him, causing a ramrod he had in his hand to enter the thigh. At the time the shell exploded there was a soldier standing between him and it. On arrival in camp his trousers were found to have been literally blown off him, and a long lacerated wound extended down the anterior aspect of the thigh, but there was no appearance of an extraneous body. Several days after, the limb became very much swollen, discharge from wound copious and dark coloured, and the back of the thigh presented the appearance of an abscess having formed. On examining the wound with a probe, a movable foreign body was discovered, and on making an incision through the thick fascia at the back of the thigh, a long splinter of bone and several pieces of cloth were discovered. The splinter had no doubt caused the wound and not the ramrod, as was at first supposed, and was part of the thigh bone of the man who was standing between him and the explosion, and who was blown to pieces. On removal of the splinter and pieces of clothing, the wound healed rapidly, the counter opening being the exit of all discharge. Much surgical interference is often required in following up sinuses, particularly in the neck and lower extremities. Where these burrow between the muscles and fascia, counter openings, and support in the form of compresses and bandaging, will afford the best means of establishing a cure, care being taken when a bandage is applied to a limb that it is commenced at the hand or foot.

GENERAL TREATMENT OF GUN-SHOT WOUNDS.

The antiseptic method has been recommended for the treatment of gun-shot wounds, but objected to on account of the difficulty of procuring trained attendants, the time, and want of material.

Gun-shot wounds in their course of treatment will be influenced by many circumstances : derangement of the digestive system, causing fever and dry appearance of the wound ; inclemency of the weather ; moral influences, such as impatience and irritability of temper, tend to retard recovery. Fortunately, soldiers are most patient : one seldom hears a grumble or a question as to the probable effect of a wound.

The treatment of simple gun-shot wounds should be most simple ; and rest is of the greatest importance in the treatment of all wounds. The application of a piece of wet lint or linen covered with gutta-percha tissue or oiled silk, retained by plaster or light dressing, will be quite sufficient.

Ice, if procurable, may be found an agreeable application, and will tend to subdue inflammatory symptoms ; but if not comforting, or if it produce irritation of the neighbouring skin and induce a pustular eruption, it should be discontinued.

Painful Gun-shot Wounds.—When a gun-shot wound is tender, it has been recommended to apply a little oil, lard, or simple ointment ; but my experience is that greasy dressings become hard and offensive, requiring frequent renewal, and are consequently objectionable. It is, therefore, better to relieve the sufferer with opiates, or the local application of morphia—say, a quarter of a grain sprinkled on the wound.

The Use of Bandages.—Mr Guthrie had a very strong objection to rollers for the dressing of wounds. He says they become stiff, bloody, and dirty. He considered they did no good, and were for the most part cut off with scissors and rendered useless. On this point, however, Hamilton, of the U.S.A., remarks : “No part of the dressing of a gun-shot wound has more value, when judiciously employed, than a roller. At the same time, nothing is capable of doing more harm. If a roller is carefully applied to the limb at an early period, much of the bleeding is prevented, and most of the blood which does escape flows out freely from the orifices, which are left open purposely ; and thus we are apprised not only of the amount of bleeding, but those extensive intermuscular extravasations are avoided.”

The application of warm water may be followed by relief and benefit, if applied by means of *spongio-piline* to the trunk, neck, and upper portion of extremities. Professor Esmarch, in his work on Bandaging,* describes baths for both extremities, which I saw in use in the German hospital, Versailles, during the Franco-German war, 1870–71, and which appeared to afford great

* “Verbandplatz und Feldlazareth,” Dr F. Esmarch, p. 72.

comfort to the sufferers using them. The illustration (fig. 73) represents one of these baths for the lower extremity; those for the upper being somewhat longer, as shown by fig. 74.

Esmarch says: "For lengthened immersion it is best to use the arm and

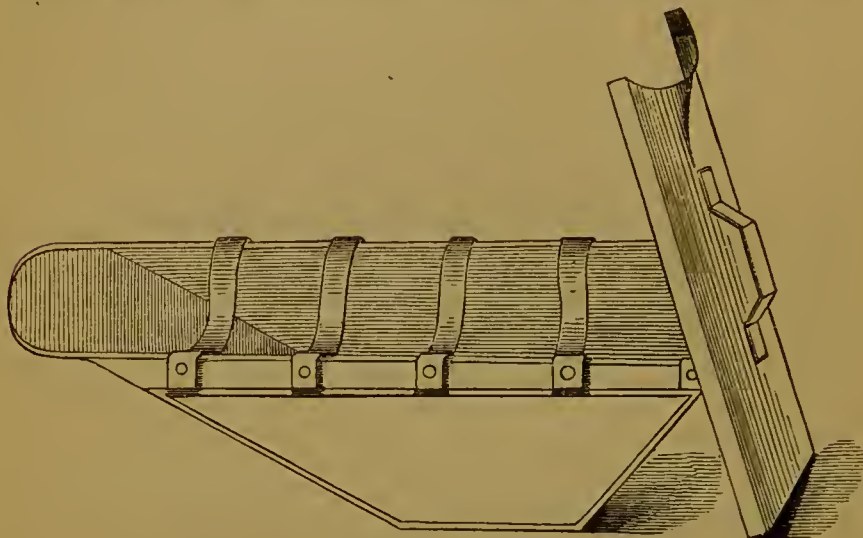


Fig. 73.—Foot Bath.

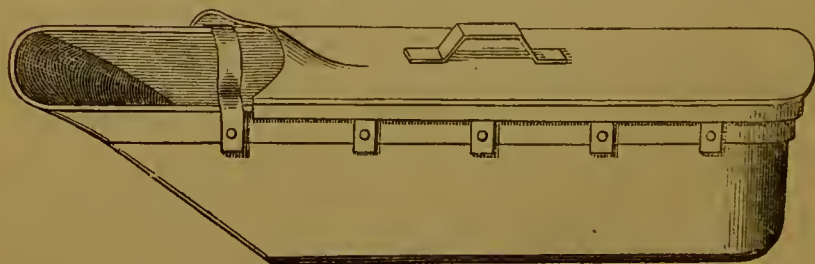


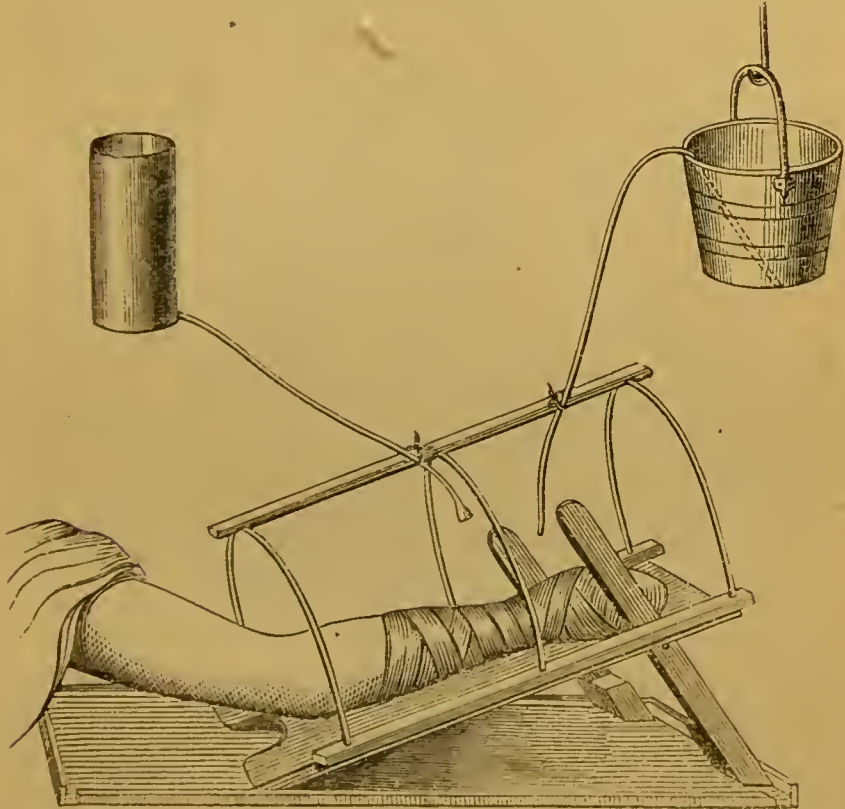
Fig. 74.—Arm Bath.

foot bath of plated zinc, numbers of which can easily be prepared for clinical as well as field hospitals.

The wounded limb should be laid on the suspension straps, which are fastened on either side to metal buttons, so that it will be suspended in the middle of the water. For later steps of suppuration, these baths will be

found most useful and comforting, especially in cases of excision of joints or wounds of soft bones where immersion can be conveniently applied, but it is necessary to watch most carefully from day to day the effects, as in several instances when long continued, phlegmonous inflammation occurred, due, probably, to the increased activity of the local circulation.

Irrigation has been advocated by some army surgeons. It is a perfect



F g. 75.

method of lowering the temperature of a part, and therefore useful in allaying inflammation in injuries of joints.

To carry it out effectually its application must be sufficiently prolonged, as, in the event of its being suspended for a short time, reaction will set in and the inflammatory symptoms will be more severe.

Esmarch, in his work on Bandaging, &c., gives an illustration (fig. 75) of

a very simple plan for using or applying irrigation. By placing a vessel containing water above the level of the patient, the fluid may be conducted to the affected part by means of a syphon formed of gutta-percha or other tubing, or by means of a piece of cotton-wick or skein of worsted, which will act after the manner of a syphon. A vessel may also be constructed with a pipe near its bottom, to which a tube may be attached.

Velpeau recommends the apparatus for irrigation as shown in fig. 76.

Irrigation is best employed by first laying upon the wound a piece of lint,

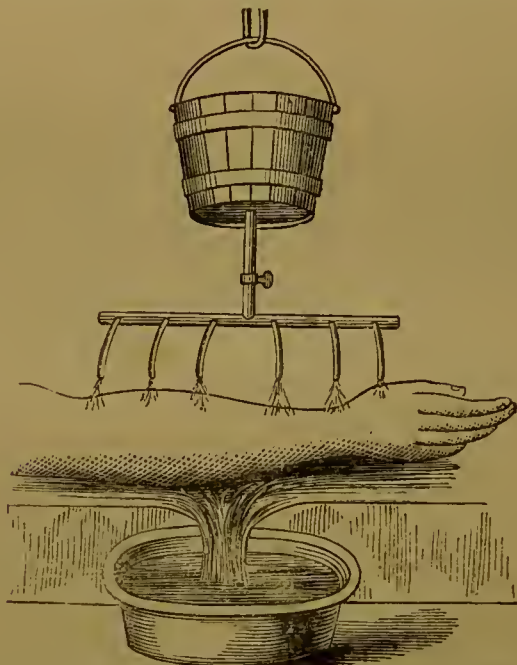


Fig. 76.—Velpeau's Irrigating Apparatus, from Dr Billroth's "Surgical Pathology," p. 73.

cloth, or other soft dressing, much larger than the wound itself, so that it extends several inches beyond its margin. Arrangements should be made on and under the patient's cot for carrying off and collecting the water as it falls off the limb or wounded part.

Washing Wounds.—While on the subject of irrigation I beg to recommend a most excellent plan for washing or irrigating wounds, as represented in fig. 77. A gentle or strong stream of water can be applied to any wound, quite

doing away with the use of sponges, which are generally not numerous, and, if present, may be the means of setting up unhealthy action in healthy wounds, from having been previously used.*

With the kidney-shaped tray, as shown in fig. 77, any part of the body may be irrigated without wetting the patient's clothes or bed clothes.

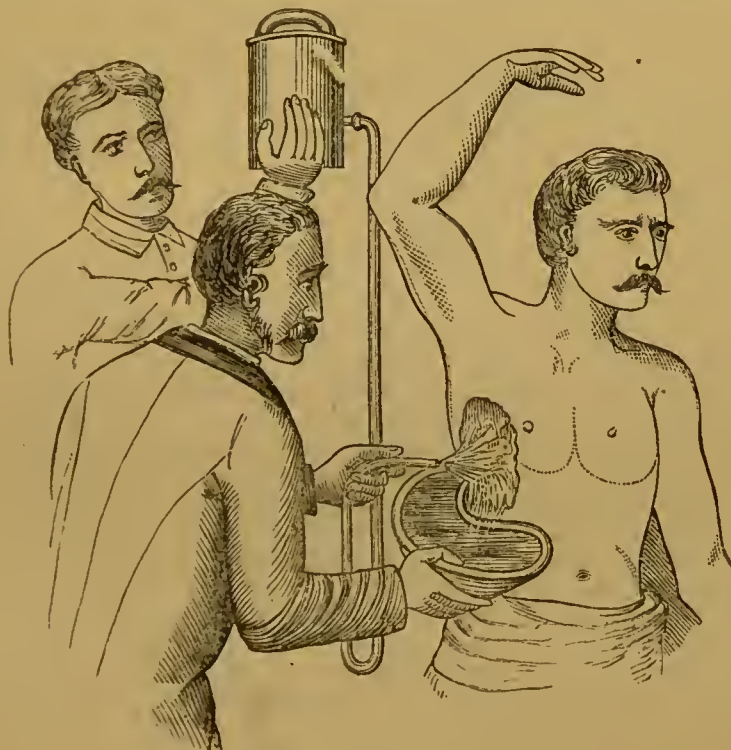


Fig. 77.

Poultices, though useful at times, are most objectionable, and should be avoided as much as possible in military hospitals on active service. When persistently used, they are frequently the means of assisting in establishing cases for amputation which might otherwise have turned out favourably. When no longer required, poultices are with difficulty disposed of, orderlies and sick (if not most carefully watched) depositing them in holes and corners

* This plan of irrigation was seen by the writer in the German hospitals, Versailles, during the Franco-German war, 1870-71.

where they are least suspected, and where they become putrid, sour, and encourage flies.

Disinfectants.—It is of the greatest importance that every precaution should be taken against the decomposition of sloughs and discharges, and for this purpose the following disinfectants have been recommended, which may be divided into two classes :—

1. Those which prevent or modify decomposition.
2. Those which neutralize products of decomposition.

Under the first class may be included—

Carbolic acid, which in the present day appears to stand foremost in the opinion of some; also permanganate of potash, chloride of zinc, nitric acid, and nitrate of silver.

Under the second class may be included—

Chloride of lime or soda, charcoal, and iodine.

Carbolic acid should be applied in weak solution, say 2 parts in 100 of distilled water, oil, or glycerine. If applied too strong, it produces pain and irritation.

Permanganate of potash may be used of a strength according to the nature of the wound, one of an offensive character requiring a strong solution. It should be applied with a glass syringe, as contact with sponges, lint, or cloth decomposes it and renders it useless.

Chloride of zinc should be used in solution, care being taken not to make it too strong, or it will produce great irritation.

Nitrate of silver should be used in solution of from 10 to 20 grains to the ounce of distilled water; applied with a syringe.

Nitric acid will be found useful in phagedænic ulceration, and may be applied in a pure state, or as a lotion.

Chloride of lime may be used in solution with water as a lotion, or for disinfecting the air.

Charcoal may be used sprinkled on a poultice, applied in powder, to a wound or ulcer, or in muslin bags, which latter proceeding is most clean and convenient.

Iodine may be used for disinfecting the air, or as a lotion.

Petroleum has been recommended by Dr. C. Paul, who directs that the wounds should be thoroughly cleansed and then covered with saturated lint, and where there has been deep-seated destruction of tissues, charpie fully impregnated with it should be packed into the cavities, and the whole overspread with oiled silk, waxed paper, or a piece of muslin spread with lard.

Tannin has been strongly recommended by Professor Fleck of Dresden, and also by Herr Graf of Elberfeld, who combines it with cotton wool.

Salicylic acid has of late been much used as a dressing, either dry, or in the form of a solution. It is clean, as a rule painless, and without any unpleasant smell; it is difficult to dissolve in water, but by adding borax, solu-

tion is soon accomplished. A suitable lotion may be made with 3 parts of salicylic acid, 2 of borax, and 100 of hot water.

Terebene has of late years been advocated as a surgical dressing, and certainly as a deodoriser nothing can be better. It may be used as a lotion in the proportion of one ounce to a pint of water. If too strong, it causes pain.

Dry earth, as advocated by Mr. Hewson of Philadelphia, is a powerful deodoriser, and may be used with advantage in foetid wounds applied in very fine gauze bags. The writer, in a case of fungus hæmatodes, which was extremely offensive, found it the only application which effectually destroyed the fetor.

Thymol, the essential ingredient of oil of thyme, has been introduced by Volkman as an external antiseptic. It is bland, has no hurtful effects on the system at large, and does not irritate the parts to which it is applied. The following formulæ are recommended for external antiseptic purposes :—
Thymol, 1 gramme; alcohol, 10; glycerine, 20; water, 1000 grammes.

Cotton-wool dressing for wounds was introduced at the end of 1870 by M. Guérin. This plan of treatment consists in surrounding the wounded limb by very large quantities of cotton-wool, and rendering the whole dressing firm and compact by tightly applied bandages, which are left undisturbed for several weeks.

The wool employed must be of good quality, clean, and free from impurities. If there be a glazed surface, this must be stripped off, and the sheets of wool, torn into long strips about a foot wide, must be rolled up so that they may be methodically applied round the part. The quantity of wool used at a dressing is sometimes enormous, Guérin having employed as much as four pounds. It has to be securely fixed in its place by means of bandages, which establish a considerable amount of elastic compression.

Chloralum wool has the reputation of being a powerful styptic and antiseptic. It is recommended for the treatment of recent wounds, cuts, and foetid discharges. It was extensively used by some of the British ambulances during the Franco-German war of 1870-71, and the Russo-Turkish war of 1877-78, with satisfactory results.

Vanilla in solution, Surgeon-Major J. Fleming states, was used by the Spanish army surgeons at San Sebastian during the war in 1875, and from its pleasant smell was found most agreeable.

Sawdust derived from one of the pine species, and enclosed in thin gauze bags, has been used by the author with advantage in suppurating offensive wounds. It should be fresh, and the bags only two-thirds full. It is a good absorbent, soft, painless, clean, and a powerful deodoriser. A piece of perforated oiled lint should be placed between the pad and wound.

Other dressings have been recommended besides those already mentioned, such as glycerine on lint or charpie. Carded oakum and carbolic tow are

excellent dressings for absorbing discharges and keeping down offensive smells. Tincture of arnica, with water, may be used as a stimulating dressing ; diluted alcohol ; or tincture of the perchloride of iron, in weak solution.

For recent wounds, *Peruvian balsam* has been recommended by Dr. Weiss of Berlin, *Norwegian tar* by Dr. Sarazin, *perchloride of iron* by Dr. Knowlton of Ohio, and *boracic acid* by Dr. L. Cane.

Above all, in the local treatment of gun-shot wounds, cleanliness must be attended to, as without it no treatment can be successful.

The proposal on the part of Professor Chisholm, of South Carolina, to *pare the edges of gun-shot wounds* in such a way as to prepare them for healing by the first intention, has not been found to succeed by most surgeons. This plan was originally suggested by Desault and Larrey in wounds of the face. Professor Chisholm was desirous of having the same proceeding for all wounds.

The Director-General, Medical Department U.S. Army, says, that from the experience and evidence adduced, the results were not satisfactory, and he considers that by attempting to regulate such wounds by the knife, there is great liability of sacrificing more tissue than Nature would have done.

The *pneumatic system of healing wounds*, as introduced by M. Jules Guérin, has been mentioned by Surgeon-General Gordon, who considers that in its present state, although suitable enough for a stationary hospital, it is utterly unsuited to a movable one. The apparatus having been provided, "the wound should be dressed in the ordinary way, then apply to its surface charpie moistened with tincture of arnica, over that a little oakum, then a bandage moistened with arnica lotion. The air-tight case of india-rubber should now be applied, the tube extending from it being connected with an exhausting glass vessel, from which another communicates with the air-pump. The glass vessel has, moreover, a third opening, by which liquids reaching it from the wound may be discharged without deranging the apparatus in any way ; and by means of the ingenious mechanism contrived by the inventor of the apparatus, the action of the air-pump can be reversed, so that the lotion of phenic acid, permanganate of potash, or other remedy, may be applied to the dressings of the wound without taking any of them off. Grave wounds are dressed by M. Guérin once a day, those of a slighter nature once every five or six days. In all cases it is necessary for success that the apparatus be applied to the wound before inflammation sets in, and that during the treatment the patient be well supported by food and extras."*

Constitutional Treatment.—The constitution frequently requires looking after, the regulation of diet being essential. Cases may occur, such as in wounds of the lungs, where it may be necessary to reduce the patient to a state bordering on starvation ; the contrary, however, may be indicated in weakly patients, and after prolonged suppuration or exposure to privation.

* Gordon's "Lessons on Hygiène and Surgery," p. 130.

Sanitary Treatment.—The surgeon should observe strict sanitary precautions about the patient's person, bedding, and clothing, and, when it is possible, ample *cubic space* should be given to each person; for wounded, at least 1200 feet each in buildings. In huts and tents the allowance may be less.

Ventilation of buildings is of the greatest importance; but it must be observed that, though ventilation is necessary, a wounded soldier may have too much of it, and in the treatment of gun-shot wounds *too low a temperature*, or currents of air, may be attended by most serious consequences. During the Crimean campaign and the late Franco-Prussian war, the influence of temperature on suppurating wounds was most remarkable. In the Versailles hospitals many of them took an unhealthy action when the temperature of the wards became very low.

Delirium.—Traumatic delirium, as a complication of gun-shot wounds, is occasionally met with. The difference between it and delirium tremens from excessive alcoholic drinking, observes Mr Longmore, is chiefly marked by the absence of the trembling condition of the limbs.

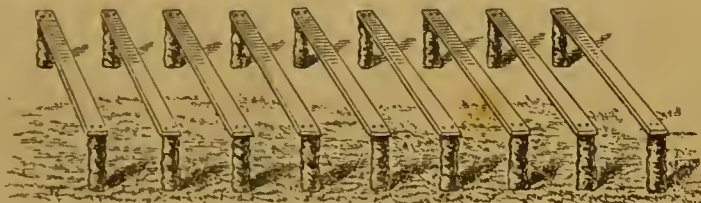


Fig. 78.

The special causes which appear to give rise to it are a lowering of the constitutional tone by fatigue, especially such as arises from excessive night duties, broken rest, watching of an anxious and responsible character, long and harassing marches, exposure to inclement weather, irregular meals, loss of blood, shock, pain, indulgence in alcohol before or at the time of being wounded, excess in strong tobacco, or an irritable state of the nervous system.

In the treatment the surgeon should study the cause which may have led to the attack in each case, order support, if required, in the form of nutriment or stimulants, purgatives, leeches, or cold application to the head, but above all, efforts must be made to obtain sleep. The patient should be prevented from injuring himself.

Extemporised Bedsteads.—Bedsteads are most essential for the comfort and protection of patients; they may be improvised as already shown by figs. 16 and 17, or by two rows of stakes driven into the ground, rising 14 inches above the surface, and standing 10 inches asunder (fig. 78). The

width of the frame must be determined by the bedding, and the number of stakes by the necessary length.

Extemporised mattresses may be made with blankets or sheets stitched together, so as to form a bag, and filled with straw, hay, dried leaves, ferns, hair, torn-up paper, or shavings of wood. Neudôrf strongly recommends fine wood shavings as being soft and elastic.

Extemporised bed cradles for the protection of wounded limbs from the weight of bed clothes, as a means for supporting gauze to prevent the invasion of flies, or in the adaptation of tubes for irrigation (see fig. 75), are most important as part of hospital equipment. They may be constructed from hoops of small barrels, split bamboo, telegraph wire (fig. 79), or from metal bands, generally found in commissariat stores, having been a means of binding compressed hay.

Bayonet, Lance, Sword, and Arrow Wounds.—Bayonet and lance wounds come under the head of punctured wounds; sword, of incised; and arrow

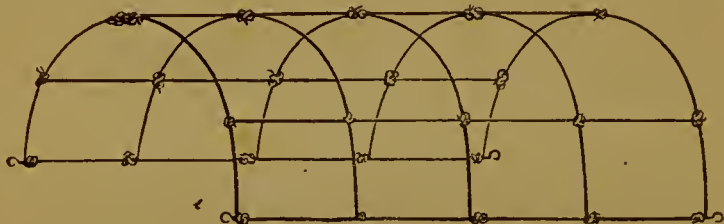


Fig. 79.

wounds as a combination of lacerated and punctured. The latter only will be considered here, as the former have been already alluded to.

Arrow wounds are not likely to be met with in warfare between civilized countries, but arrows are still in use among savage tribes, and as the army or naval surgeon might be called upon to exercise his skill in the treatment of such wounds, the following information may be found useful.

Mr. Hamilton describes the point of entrance of an arrow as being "indicated by a narrow slit, the margins of which are slightly discoloured, resembling very much the wound made by a small ball. The wound of exit resembles the wound of entrance, except that it is not discoloured, and is somewhat larger.

"Suppuration can seldom be avoided.

"Profuse hæmorrhage, extensive abscesses, empyema, and tetanus, are among the most frequent complications of these accidents, when only the external or fleshy portions of the body are implicated."

The great difficulty to be overcome in the treatment is to remove an arrow which has lodged without leaving its head; and as the missile appears to

be more or less constructed with that view, plans have been devised for removing the shaft and head together.

Dr. Bill, of the U.S.A., has invented an ingenious expedient for removing the barbed heads of arrows when buried in the soft parts of large cavities, or when impacted in bone. It consists of a snare as represented in fig. 80, the arrow shaft being used as a guide to the wire, which is thus passed over the arrow-head, and the great danger of detaching the head from the shaft is avoided.

When arrow-heads are lodged in bone, and cannot be detached by slight



Fig. 80.—Wire loop for extracting arrow-heads embedded in the soft parts.

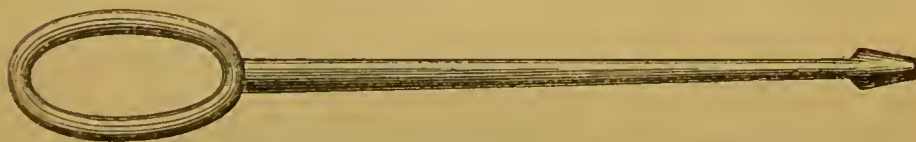


Fig. 81.—Wire-twister recommended by Dr. Bill, 12 inches long.

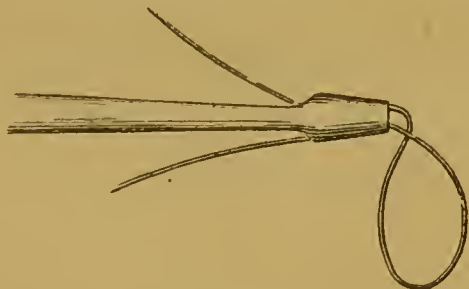


Fig. 82.—Wire loop twisted once on itself for snaring impacted arrow-heads.

traction, aided by a gentle rocking motion of the shaft, the plan which Dr. Bill advises is to procure a piece of well-annealed iron wire, $2\frac{1}{2}$ feet in length, to pass the ends through the holes in a long suture wire-twister, and secure them to its handle (fig. 81), leaving a loop at the distal extremity (fig. 82). The loop passed over the feathered end of the shaft is to be thrust down to the other extremity, and made to snare the arrow-head, and the wire being tightened, the foreign body and instrument are to be withdrawn together. Dr. Bill suggests that two straightened catheters soldered together would

answer in place of the wire-twister, and the *écraseur* now supplied with the army field-instrument cases would probably prove a yet more convenient and reliable instrument. But whenever possible, it will be preferable to cut down upon the arrow-head, and to remove it with forceps; for the surgeon should not work in the dark.

“If the arrow has passed nearly through, so that its point can be felt upon the opposite side, the surgeon should cut down upon it by a counter incision, and extract it by that route, as suggested by Larrey; and in order to facilitate its removal in this direction, he may, as soon as the head of the arrow is withdrawn, and the end of the shaft to which it is attached can be seized by the forceps, cut off the opposite end of the shaft close to the skin by a pair of bone nippers; or if he finds the head and the shaft separated, he may withdraw the shaft on the one side and the head on the other, taking care, however, that the tendinous string (a string which attaches head to shaft) is brought out with the head, otherwise it may be left in the track of the wound. The same practice may sometimes be adopted, namely, making a counter incision to reach the head, even though the head is not felt, provided the surgeon can determine the length of the shaft, and consequently the probable position of the head.

“An arrow having penetrated bone, an attempt should first be made to extract it by rocking it to and fro in a direction at right angles with the plane of the groove which is made on the outer or feathered end of the shaft.”

In the treatment of arrow wounds, remarks Professor Gross, the first indication is to withdraw the extraneous substance, and then, bleeding having been arrested, to limit the resulting inflammation by appropriate antiphlogistic measures. Long and deep incisions will often be necessary to effect dislodgment, especially if the arrow is impacted in the head of the bone, or buried at considerable depth among the muscles and aponeurosis. The best probe for ascertaining its situation is the finger.

Full anodynes should be given to prevent nervous distress and severe pain.

INJURIES OF THE HEAD.

THIS important and interesting subject has engaged the attention of numerous writers.

Mr. Guthrie remarks: “Injuries of the head affecting the brain are difficult of diagnosis, doubtful in their character, treacherous in their course, and for the most part fatal in their results.”

“The slightest injury to the head may produce effusion, encephalitis and its consequences, plugging of the sinuses by coagula, leading to coma, paralysis, pyæmia, and death; while extensive injuries (their aspects at first

threatening most serious results), such as fracture, depression, and even permanent compression, from lodgment of bullets or other extraneous substances, have been followed by no such consequences.”

Classification of Injuries of the Head.—Many classifications of injuries of the head have been suggested, but it appears to the writer that for practical purposes it will be sufficient to consider them—first, with regard to injuries of the containing parts; and second, with regard to the organs contained.

In the transport of soldiers or sailors with injuries of the head, the greatest watchfulness should be observed on the part of the attendants, in consequence of the liability to vomiting and convulsions.

Contusions of the Head.—These injuries generally occur in war from spent bullets, fragments of shells, or other missiles, the velocity of which has been nearly expended; or they may occur indirectly from splinters of stone, wood, &c. Whatever their origin may have been, or no matter how slight the contusion, they should be most carefully examined and watched. Mr. Liston has remarked that “wounds of the head of the most trivial character are not to be despised, or of the most severe not to be despaired of.” This maxim should always be kept in view.

The treatment of simple contusion consists in the application of cold water to the part, and the administration of cathartics, light diet, no stimulants, and most perfect quietness.

Severe contusions, accompanied by a tumour, are sometimes difficult to distinguish from depressed fracture, the centre of both giving to the hand a hollow or depressed feeling. To the inexperienced these bloody tumours are a source of great perplexity, but they will in general be distinguished by their having a well-defined margin or wall, and when the hand is passed over from the sound part, it will first feel this hard wall or margin, and then suddenly experience a soft depression in the centre of the tumour.

In a fracture with depression there will be no defined margin or soft centre, the depression being gradual and hard to the touch; besides, there will in all probability be symptoms of compression accompanying the injury.

These tumours may give trouble by suppurating, the effused blood acting as a foreign body; but as a rule they become absorbed with the use of cold applications. When, however, suppuration takes place, the tumour must be incised, and free exit made for the escape of matter. Severe contusion, accompanied by an open wound, may be followed by erysipelas, abscesses, periostitis, or necrosis, as well as inflammation of the brain and its membranes.

The treatment of these contusions does not differ from similar injuries in any other part of the body; but with complications of erysipelas, abscesses, &c., the treatment requires to be most active, in consequence of the close proximity of the brain and possibility of inflammation extending.

Contused Wounds, with Fracture of the Cranium, without Depression.—These injuries but seldom occur, and, as regards the fracture, are difficult of diagnosis; a fissure through both tables may exist, without producing any alarming symptoms or external evidence.

Mr. Erichsen (*Lancet*, Jan. 5, 1878, p. 2) mentions that in blows on the side of the head where there are symptoms of compression and bulging at the seat of injury, the result of a fissure in the cranium through which blood has come, giving rise to the projection of the temporal muscle, it is right to trephine, and that the position selected should be over the course of the middle meningeal artery, which may be discovered by taking a point an inch and a half above the zygoma and an inch and a half behind the external angular process of the frontal bone; where these two points meet, the artery will be found.

Furrowing of Outer Table.—There may be furrowing of the outer table without injury to the inner, this being caused by the passage of a ball across the skull, striking in such a position that it does not enter—in fact, a graze of the bone—which as a rule is followed by most unpleasant symptoms, such as inflammation of the brain and its membranes, necrosis, and abscess.

In the treatment the surgeon must be guided by the amount of constitutional disturbance and cerebral symptoms, applying local remedies such as are recommended for contusion with open wounds, subduing inflammation, and keeping the patient perfectly tranquil.

Contused Wounds, with Depression.—These injuries are as a rule so connected with the consideration of compression, that it is scarcely necessary to touch here on the subject. It may, however, be stated that patients have recovered from such injuries without the depression being elevated; the surgeon must therefore be guided by the urgency or otherwise of the symptoms, in deciding as to the necessity of cutting down or dividing the scalp to examine the bone, and so form an originally simple fracture into a compound.

Sir A. Cooper, Abernethy, and Dnpuytren, recommend that, if the depression does not produce symptoms of compression, it is best not to interfere. Mr. William MacCormac remarks on this subject: "One point regarding which opinions vary somewhat, is respecting the treatment of depressed fracture unaccompanied by symptoms, and with an external wound. Where there is no wound, he would be a hardy operator who should cut down upon a depression in the skull, in the absence of any symptoms of compression. When there is a wound, however, the case is different; but even here I question much if the surgeon ought to do more than simply remove such loose fragments as can readily be got at."

Penetrating wounds of the cranium generally prove fatal; but instances have occurred of recovery when the bullet or other missile has been surrounded by lymph, and the brain become accustomed to its presence.

When a missile has entered the brain, it is almost impossible to remove

it, and an attempt to do so may only cause further injury ; f, however, it can be felt superficially, it should be removed.

Fracture of the Inner Table of the Cranium.—The inner table of the skull may be fractured without signs of depression, or fracture of the outer table, or detachment of the pericranium. On this description of injury Guthrie remarks that, in the great number of broken heads under his care on many different grand occasions, he has never actually known the inner table to be separated from the outer, without positive marks of an injury having been inflicted on the bone or pericranium. An operation, he says, should never be performed under the expectation that such an accident may have happened, unless it be apparently required by the urgency of the symptoms, indicating compression or irritation of the brain, which cannot be relieved by other means, and are about to prove fatal.

Fracture of both Tables.—There may be comminuted fracture of both tables, without producing the slightest symptom of compression, the bone having been broken into such small pieces that they rest loosely on the dura mater, and cause no cerebral symptoms; the treatment in such a case being cold applications and perfect quietness, with strict observance of diet, and no excess.

Fracture from Contre-Coup.—This accident, causing a fissure of the parietal bone, or fracture at the base of the skull, where it is most common, is of rare occurrence in the army. Out of 12,980 injuries of the head during the American War of the Rebellion, there were only two cases recorded of this peculiar injury. The fracture is accounted for by a heavy blow being struck against a hard resisting part of the skull, and the shock transmitted, causing the thinnest and most brittle portion, though at some distance, to give way.

This fracture is never depressed, and is very difficult to recognise. In some instances it has been diagnosed by a sensation of crepitus being given to the hand when the head has been gently moved.

The treatment should be entirely constitutional, consisting of mercury, according to gravity of symptoms, and purgatives, the head being placed on a soft pillow.

Fracture of the Base of the Skull.—A fall from a height, or a blow on the vertex or side of the head, may produce this description of fracture, which usually extends from the point struck across the base of the skull, not unfrequently running through the petrous portion of the temporal bone or into the foramen magnum. This is a most serious accident, and very commonly attended by fatal results; still, there are instances of persons having lived for a considerable period after such injuries. Writers on this subject have endeavoured to lay down rules or particular signs and symptoms for certain seats of fracture in the base of the skull, but unfortunately such definite information does not help one in the treatment; it may, however, assist the surgeon in forming his diagnosis.

A fissure extending through the *anterior fossa* may be accompanied by extravasation of blood into the orbit or eyelid, or there may be free hæmorrhage from the nose.

Should the *middle fossa* be implicated, there will very likely be fracture through the petrous portion of the temporal bone, with injury to tympanum; there will then be a discharge of blood or serum from the ears.

When the *posterior fossa* has been fissured, there may be some difficulty in distinguishing the exact nature of the accident, unless the fracture passes through the petrous portion, and then there will be the characteristic signs of such an injury.

Mr. Erichsen considers that "there are two signs, the occurrence of which, separately or together, leads to strong presumptive evidence in favour of the existence of this kind of fracture. These are, first, the escape of blood from the interior of the cranium through the ear, nose, or into the orbit; and secondly, the discharge of a serous fluid from the ears, and occasionally from other parts in connection with the base of the skull." He further says: "Bleeding from one or both ears after an injury of the head may arise from any violence by which the tympanum is ruptured, without the skull being necessarily fractured. If, however, the hæmorrhage be considerable, trickling slowly out of the meatus in a continued stream, if the blood in the external ear pulsates, and more especially if the bleeding be associated with other symptoms indicative of serious mischief within the head, and if it have been occasioned by a degree of violence sufficient to fracture the skull, we may look upon its supervention as a strong presumption that a fracture of the base of the skull, extending into the petrous portion of the temporal bone, has taken place.

"Hæmorrhage into the areolar tissue of the orbit and eyelid, possibly with protrusion of the eyeball itself after, accompanies fracture of the orbital plate of the frontal bone. The ecchymosis that occurs in these cases arises from the filtration of the blood from the anterior of the skull, through the fracture, into the loose areolar tissue contiguous to the injured bone. It differs remarkably in appearance from that resulting from a direct blow upon the eyelid—from a 'black eye.' In the latter case there is bruising of the skin, and the ecchymosis is in a great measure cutaneous, of a reddish-purple colour. In the ecchymosis from fracture, the hæmorrhage is entirely subcutaneous. There is probably no bruising of the eyelid, but this is tense, greatly swollen, and of a purple colour. The extravasation can clearly be seen not to be in the skin, but to shine through it."

The discharge of serum from the nose or ear, which in the latter "wells up" as quickly as it is removed, and may flow to the amount of several ounces, is generally admitted as a certain sign of fracture of the base of the skull.

Scalp wounds frequently occur to artillery men, at the rapid practice of

mounted artillery, by men being thrown off the gun carriage when going very fast, and a wheel meeting with the man's head will detach a large portion of the scalp. When such accidents occur, it is only necessary to clean the exposed surfaces and replace the torn scalp, when in all probability the parts will heal without any trouble. Occasionally the surfaces will not unite, even under the most careful management; but certain portions will do so, abscesses very likely forming in other parts. Care should be taken to evacuate the abscesses at an early period by adequate incisions.

If the scalp has been much bruised, it may not adhere until suppuration has taken place; when well-regulated pressure will expedite recovery.

Sabre wounds on the top of the head are not by any means so dangerous as those on the side. Sabre cuts will generally admit of being at once replaced, and in many instances, with the aid of a few stitches and proper supporting bandage, they adhere without further trouble. With section of scalp, cranium, and even brain, from a sabre, recovery may take place.

Erysipelas of the scalp generally occurs after contusion or punctured wounds, influenced by the constitution of the patient and the sanitary state of the hospital and its neighbourhood. The treatment should be regulated by the powers of the patient and state of constitution. In the milder forms, where there is simply a reddish blush, the parts should be punctured with the point of a lancet, followed by warm applications, such as poultices. In the severer form, where there is great puffiness, without redness, the parts should be incised, the incisions being 2 to 3 inches long, and warm poultices or fomentations then applied. The bowels should be regulated, and if the constitution be low, wine, ammonia, bark, and good diet, must be administered.

Pyæmia is not an unfrequent complication of injuries of the head, but it is after slight injuries to the scalp, not cerebral, that the disease presents itself; in the case of the severer injuries, the sufferer not living sufficiently long for the disease to develop itself. The character of the disease does not differ when in connection with these wounds from its nature elsewhere. "The general line of treatment is the same as for pyæmia from other causes; but it has been suggested, with a view to prevent its development, when there has been contusion of the cranium, to remove the diseased bone with the trephine. The operation would be attended by dangers peculiar to itself; there would be no limit to the parts to be removed, and no certainty as to necrosis attacking the contused bone after the injury, and consequently the operation is not considered justifiable."

Injuries of the head affecting the brain have been divided into injuries from concussion and injuries from compression or irritation of the brain.

Concussion.—It is difficult to explain what concussion really is, but it appears to be a shock communicated to the nervous system, in consequence

of some external injury or violence producing disturbance of the substance of the brain and interfering with its circulation.

The functions of the brain may be temporarily suspended, insensibility being slight and transitory, or it may be prolonged for several hours, or the patient may sink without recovering consciousness.

The symptoms and signs of concussion are influenced by the extent of the injury to the brain. When very slight, the feelings may be only faintness, giddiness, or mental confusion; but when the injury is severe there will be insensibility, and the surface of the body will be cold and pale; the sufferer, when spoken to in a loud tone, may answer in an incoherent manner, falling again into a state of semi-unconsciousness; muscular power is lost, the pulse feeble, the bladder and bowels act involuntarily, the pupils are contracted, breathing appears to have ceased, circulation has been suspended. This condition may last for a few minutes or hours, and is the first stage; its duration depends on the severity of the shock. In the second stage stupefaction continues, though the patient may be cognizant of being moved or roughly handled. It may be possible to rouse him, which partial consciousness is in favour of there being no compression: and when the pupils are contracted (both being alike) it is also a symptom in favour of there being no compression.

Vomiting may occur, which is generally considered a good sign, as it stimulates the heart's action, and causes the blood to flow through the vessels of the brain. As circulation is being gradually established, the pulse becomes fuller, and the surface warmer. When the injury has been more severe, the symptoms are more marked; there is complete prostration, eyes glassy, pupils may be contracted or widely dilated, surface cold; and, in fact, the patient appears moribund. These symptoms may last for hours, or merge into the severer complications of compression.

In concussion the breathing is rarely stertorous, a symptom which if present and continual, might be considered as of compression.

Treatment of Concussion.—In the first stage, or that of collapse, the patient should be let alone and allowed to rally; but if it is extreme or unusually prolonged, an endeavour should be made to revive the energies of the nervous system and circulation by application of warmth to the body by means of hot jars or bottles, blankets, and employment of friction to the surface. Administer warm drinks, but no stimulants, unless reaction cannot be brought about without them, and then they should be given in very small quantities, their action being carefully observed. The administration of an enema, containing some aromatic spirits of ammonia, has been recommended. Reaction having taken place, the object is to try and prevent inflammatory action. There should be perfect quietness, mentally and bodily, in a darkened room, the latter having a decided influence in preventing congestion. Cold should be applied to the head, mercurial purgatives

administered, stimulants avoided, or excess in diet or excitement of any kind. Should symptoms continue, blood may be extracted from the back of the neck by leeches, or cupping, or general bleeding may be considered necessary. Blister to back of neck, or the insertion of a seton, have afforded relief in protracted cases.

Should inflammatory symptoms become apparent, the treatment must be most active: bleeding from the arm, the most powerful remedy we have, should be regulated by the pulse, and repeated as often as the symptoms recur. The head should be shaved and ice applied; mouth touched by the administration of mercury as quickly as possible, either by inunction or by the mouth. Perfect quietness must still further be enforced.

During the convalescence, when the constitutional powers become depressed, small quantities of stimulants may be given, or, where there is sleeplessness and delirium, opiates give much relief.

Compression means pressure on the brain by a portion of bone, bullet, extravasation of blood, or formation of pus, or anything that may press on it or enter its substance, causing characteristic symptoms, some of which are as follows:—insensibility, breathing heavy, laboured, slow, accompanied by stertor; cannot be roused; there is a peculiar noise caused by the breath being emitted from the corner of the mouth, something like a puff or whiff, caused by the velum pendulum palati hanging down in the mouth; the pulse is usually slower than is natural, but at times irregular and occasionally quick. If the shock has been slight, the countenance is flushed; but if it has been great, it will be found pale and livid. The sufferer may be convulsed and unconscious of anything about him.

The pupils appear to vary according to the part of the brain injured, and are not affected by the degree of injury. At first they are generally contracted, subsequently dilated, or one may be contracted and the other dilated; and as the disease advances, or becomes aggravated, they are immovable. The lips are usually compressed, and if an attempt is made to give fluids they run out at the corners.

There may be paralysis of one side, or of one side of the face; paraplegia or hemiplegia.

At first the secretions are retained; subsequently they pass involuntarily.

If the injuries have existed for a day or so, it may be necessary to diagnose between compression from extravasation or from depressed bone, or inflammatory effusion within the skull.

In cases of depressed fracture the symptoms are uninterrupted, and on careful examination the existence of an injured bone will in all probability be discovered.

In cases of effusion from pus, lymph, or serum, the result of inflammation, causing pressure on the brain, symptoms of cerebral inflammation will precede the symptoms of compression.

Treatment of Compression.—A wounded soldier, suffering from symptoms of compression, appears before the surgeon: the first consideration will be, What is the cause of it? and if that can be ascertained, What shall be done to relieve him? The cause, however, may be obscure, arising from damage within the skull, and probably beyond the reach of the surgeon. The treatment in such a case should be constitutional, and very guarded. Watch for continuance of symptoms, and, if not relieved, an endeavour should be made to bring the sufferer as quickly as possible under the influence of mercury, cold to the head, and perfect quietness, with a view to prevent the approach of inflammation. Bleeding may also be adopted.

In cases arising from causes apparent to the surgeon, such as depression of the inner table of the skull, or depression of both tables, with lodgment of bullet or other missile, the treatment is a matter which will require the most grave consideration.

The wounded soldier should be most carefully examined, with a view to discovering the source of compression, and should the most rigid antiphlogistic treatment not relieve the cerebral symptoms, it will be necessary to consider the advisability or otherwise of using the trephine, elevator, or saw; but on this point numerous and adverse opinions have been expressed by some of the most eminent civil and military surgeons.

Mr. Hennen considers that all extraneous matters should be removed; that fractured portions of bone, if they lie loose, be extracted; and that depressed portions be elevated when it can be done without the infliction of additional violence, but to keep in view the tendency of the brain and its membranes to inflammation.

Mr. Brodie is in favour of non-interference, and says, Ought we not to regard it as a general rule that the extraction of a bullet should not be attempted? an exception to the rule being only made in those cases in which, from its mere superficial situation, and other circumstances, the extraction can easily be accomplished without employment of force.

Mr. Guthrie remarks with reference to the question—What is to be done where there is breaking down and splintering of the inner table with depression? there can be no hesitation in answering that in all such cases the trephine should be applied, although no symptoms should exist, with a view of anticipating them. He considers that the danger resulting from the application of the trephine in such cases bears no proportion to the risk incurred by leaving the broken portion of the bone as a constant cause of irritation.

Professor Longmore says, that when irregular edges, points of pieces of bone, or foreign substances are forced down, and evidently penetrate, not merely press upon the cerebral substance, or where abscesses manifestly exist in any known site, and relief cannot be afforded by simpler means, at the wound itself, trephining is a proper operation to be resorted to for effect-

ing the necessary relief ; but in all other cases harm will probably be avoided by abstaining from trephining, while benefit will be effected by simply resorting to long-continued constitutional treatment.

Dr. Stromeyer, of the German army, abandoned the practice of trephining in 1849, though in the early part of his professional career he advocated it in complicated fracture of the skull, and after the Franco-German war—1870-71—he expressed himself as follows :—“ I have tried to exclude entirely from military practice the use of the trephine as useless in some and unnecessary in other cases.” He considers a state of coma from depressed skull no more as an indication for applying the trephine, than a comatose state in typhus as an indication to rouse the patient from it by any means except those which are in accordance with his general state—cold, for instance, but not stimulants. As soon as the fragments of the skull become detached by suppuration, the comatose state ceases by itself.

“ The great difficulty in settling this skull question consists, then, in that some patients survive the use of the trephine, or of an early extraction of splinters, and that some recover their senses very soon after the operation. This seems to be a conclusive proof of the legitimacy of active interference. But there is no depending upon it : the patient may die just as well after having recovered his senses completely, and, as experience has shown, more easily, than if you let him continue comatose by not disturbing the splinters. This might have been expected from very sound physiological reasons. By taking away the splinters at an early period in cases where the dura mater is wounded, you may open into the sub-dural and sub-arachnoid spaces ; air and acrid matters can then enter. Brain substance when bruised thus becomes putrid, while it might have been eliminated by absorption in the absence of air. Subcutaneous operations practised in modern times have done a great deal to put more stress on excluding air ; but Brodie and Dease were of opinion that access of air was to be avoided in cases of fractured skulls, and that no interference ought to take place for depression unless it was warranted by cerebral symptoms.”

Surgeon J. G. F. Holston, of the U.S. Volunteers, gives his experience of operative interference in wounds of the head, in the following words :—“ I will briefly state my views of trephining under the three heads of primary, intermediary, and subsequent operations.

“ Primary operations are indicated—1st, when the scalp is wounded and subjacent bone broken, so as to press upon a portion of the brain that cannot be relieved in any other way ; for in this case the brain has already suffered, and will suffer still further injury, if not relieved. Commonly some portion may be picked away by forceps, so as to render the operation of trephining unnecessary, as by means of the lever the depressed bone may be elevated. In these cases it has been my practice to remove all depressed bone, a little more or less making no difference. I have preferred the chisel for such

removal, as the sharp edge of the chisel (fig. 83) will cut cleaner and with less irritation than the saw, the teeth of which tear the tissues, and give almost as much shock for every tooth as the chisel and mallet do at every blow.

"2d. Where a missile, clothing, &c., had entered the brain, and by cautious sounding detected near the orifice. Where they are not so found, I should make no curious exploration of the interior of the cranium, believing that the patient may be more severely hurt by exploration than by the original injury. I should content myself in such cases by removing all extraneous spicula of bone and other detrimental matter that may be in the orifice of the wound.

"3d. Where there is no external wound, but indirectly a large compression of bone on the brain. If symptoms of compression are gradually deepening, there can be no doubt but we should relieve the brain of pressure; in this case probably blood has been poured out from one of the meningeal arteries.

"I consider such operations intermediary as are performed on the patient before he has recovered from the immediate injury inflicted. These operations are by no means as successful as the first, and are generally done in



Fig. 83.—Holston's Chisel.

such cases as have not had proper treatment or attention. But there is one condition, which happens occasionally, when a certain part of the skull has been struck without external wound, or without any sign of compression coming on immediately. After several days, coma begins to manifest itself; and here we have probably to deal with suppuration, which, if not speedily provided with an outlet, will sink deeply.

"Subsequent operations are such as are performed for the removal of some difficulty left behind, such as epilepsy, paralysis, &c. As regards success, I would reckon first the subsequent, next the primary, and lastly the intermediary operations, which are least successful of all. These are the rules which guide us in private practice, but I found in my experience in the army that they did not hold good. The injuries of the head are there so much more violent that I am inclined to think non-intervention to be the safer practice. I believe I have seen more injuries of the head recover without trephining than with, so that it is an open question with me whether trephining should not be either entirely abandoned, or left to the judgment of one specially qualified in the matter."

M. L. Legonest advocates the following principles and measures. He

says that the indications for the use of the trephine are immediate and remote. "I give three reasons which are generally admitted, rather than others which might be disputed. The immediate indications can be arranged under three heads :—

"1st. A foreign body having entered the pericranium and penetrated the interior of the cavity of the skull.

"2d. The discovery of depression of the bone.

"3d. The immediate appearance of symptoms of compression, such as drowsiness, coma, paralysis, hemiplegia, with or without apparent fracture or lesion of the integuments.

"The remote signs for practising the use of the trephine are perhaps less certain than the immediate ones."

He considers that the trephine ought to be used, because it has often removed objectionable symptoms, and because surgical incisions of the meninges of the brain can be cured, as numerous instances may be cited of accidental lesions of these structures having terminated satisfactorily.

The dangers consequent on the operation of trephining are not more serious than those of compression carried on for any length of time, and the chances of encephalitis are equal in both cases. Again, he says there is no operation that has caused so much discussion as trephining, and it is perhaps worthy of remark that the greater number of reasons alleged against it are more theoretical than practical.

The opinion I have formed on this most important subject, after some experience in military practice, is;—that when symptoms of compression exist from depression of the inner table or both tables, with splintering or extravasation, it is necessary to remove the cause, if possible, by some surgical means;—and, that of the instruments in use the trephine is the most objectionable, requiring considerable force, and consequently liable to cause additional injury to the sensitive brain and its membranes. I therefore consider the use of the elevator, Hey's saw, the chisel and mallet, better suited for the operation than the trephine.

When surgical interference is necessary, too much care in the manipulation of instruments cannot be observed during the operation.

There is no operation that requires greater nicety or delicacy than the removal or elevation of depressed bone or extraneous bodies from the surface or substance of the brain; but to secure success from the expedient much is required in the after-treatment, such as perfect quietness, antiphlogistic regimen, cold to the head, and avoidance of any excitement. During the Indian Mutiny, 1857, a striking instance of this came under my observation. At the battle of Sultanpore, a soldier of the 10th Foot was wounded in the head, causing a depressed fracture which rendered him insensible. The surgeon of the regiment elevated the depressed bones, and sensibility immediately returned. The sufferer was progressing satisfactorily, when the

necessity for shifting camp produced great disturbance, and brought on a train of unfortunate cerebral symptoms, from which he died.

Some authorities have raised a question as to the best period for using the trephine, that is, on the first or seventh day. Mr. Guthrie expresses himself in the following terms: "I do not hesitate to say the first, believing the violence to be greater when done on parts already in a state of inflammation than when they are sound." Another eminent authority remarks on this point: "Danger does not arise from early operation, but from delay." There is no doubt that if it is necessary or advisable to use the trephine or elevate the bones, the sooner the operation is performed the better, so that the cause of irritation may be at once removed.

There are certain parts of the skull to which it is recommended not to apply the trephine: for instance, over the venous sinuses; the anterior angle of the parietal bone; the course of the sagittal suture; and near the base of the skull.

Sir W. Fergusson says: "The trepan may be applied in any part of the side or upper portion of the cranium, and a knowledge of anatomy will indicate where the bones are thick, or the reverse, and also where the meningeal artery or the sinuses are in danger. The latter, I should imagine, may always be avoided; the former, if it is necessary to operate over its course, may possibly be cut across, as at the side of the cranium it often runs in a canal of bone instead of being merely in a groove; a small pin of wood in such a case would suppress the bleeding, and any escape that might happen ere this could be introduced would probably be rather an advantage than otherwise; for, generally, those who require this operation have been in robust health previously.

"The irregular thickness of the bones at different parts should be remembered, and the pressure of the teeth should be made light or heavy in proportion. At the frontal sinuses Sir Charles Bell recommended that the inner table shall be taken out with a smaller-headed trephine than that which has been first applied; the larger external opening permitting the entire circumference of the cutting margin of the latter instrument being placed directly on the surface within; such an operation must, however, be rarely required in this situation."

The secondary consequences of injury to the brain are—inflammation or traumatic encephalitis, deposit of pus within the organ or upon its surface or membranes.

Inflammation of the brain may occur at any period after receipt of injury. It may set in immediately, or not for many days or even weeks.

The symptoms of inflammation of the brain and its membranes being so much alike, that where one is affected the other is certain to be so, it would be impossible to draw any line of distinction.

Suppuration within the cranium has been divided into subcranial, intra-

meningeal, and cerebral. By subcranial is understood a deposit of pus between the skull and dura-mater. It occurs opposite the seat of injury or part struck. It may be induced by a blow on the head, causing separation of the dura-mater from the bone by disturbing vascular connection and setting up inflammation of pericranium with necrosis; or irritation caused by splinters of inner table, as in depressed fracture.

With intrameningeal suppuration there is an accumulation of pus in the sub-dural or sub-arachnoid spaces, or in the pia-mater. In the intracerebral form there is an abscess in the substance of the brain itself, caused by direct injury, by splinters of bone, bullets, or other missiles, or by contre-coup.

Treatment of Inflammation of the Brain and its Membranes.—The treatment should consist of most vigorous antiphlogistic measures—local or general bleeding, mercury, and cold to the head; these measures having been fully tried, without any abatement of the symptoms, the question of trephining arises in anticipation of pus having formed, but the surgeon has to solve two difficulties before attempting such an operation.

1st. Is he certain that suppuration has taken place?

2d. Where has it formed, that the trephine may be applied to allow of its escape?

Trephining in case of Suppuration.—Suppuration may be suspected when the inflammatory symptoms are interrupted by a rigor, or accompanied by hemiplegic paralysis on the side opposite the seat of injury. The formation of a puffy swelling on the scalp over the seat of injury has been suggested as the proper position to apply the trephine, but there would be no certainty in finding pus; the trial has, however, been attended by success.

Hæmorrhage has occurred to such an extent in injuries within the cranium, that it has been necessary to ligature large arteries. Fortunately this is a rare occurrence.

Protrusion of the Brain or Fungus, or Hernia Cerebri.—This arises in consequence of the dura-mater having been torn, or by ulceration taking place after removal of a portion of the skull.

If the dura-mater remains whole, and the wound in the cranium is small, the hernia will not take place, or if a large portion of the cranium has been removed, there will be no protrusion. Mr. Guthrie is of opinion that it is more likely to take place with a small opening than a large one. At first the protrusion may only consist of coagulated blood, appearing within one or two days after the injury, and is generally a fatal symptom. It may occur at a later period, when it will consist of brain substance and attain the size of a small orange. It is a very dangerous complication; terminates usually in encephalitis, followed by delirium and coma, consequent on inflammatory effusion within the skull.

Treatment.—It has been recommended to shave off the fungus, apply a wet compress of lint, and a bandage. In a few instances this course has

been followed by granulation of the surface and cicatrisation of the wound ; but as a rule the fungus grows again, and the patient is destroyed by irritation and coma.

Application of Trephine as recommended by Sir W. Fergusson.—"The scalp must be sufficiently opened by a



or any other incision that may be most convenient ; next a perforator should be applied to make a hole in the external table, into which the central pin of the trephine should be placed, and then by rotatory motion the teeth should be carried into the bone. The external table and the diploe may be cut with bold and free movements, but caution is required when the inner plate is encountered, as also in those parts where there is no diploe, and where the thickness is irregular and uncertain : the centre pin should now be drawn above the level of the serrated edge of the saw, and again, by more cautious movements, the vitreous table must be divided. When the incision is supposed to be nearly completed, the instrument must be removed : an elevator should then be introduced, so as to raise the loosened portion, and the rest of the operation may be conducted according to circumstances. When a foreign substance, blood, or matter, is sought for under the cranium, a circular piece of bone is thus removed ; but in the case of depressed fracture, only a little more than a semicircular portion requires to be cut ; and this, be it observed by the young student, is taken from the sound portion of the bone, not that which is depressed ; for the sole object in applying the instrument in a case of this kind is to permit the introduction of a lever to elevate the portion in fault.

"In using the trephine commonly sold, it is necessary to raise them from the groove from time to time, so as to allow the particles of bone to be brushed away ; but the blade being slit up obviates this. However, towards the latter part of the operation it is proper to remove the teeth once or twice and examine the fissure with point of a probe, a slip of quill, or any other convenient article, so as to make sure that the dura-mater is not in danger from the skull-cap being thicker on one side of the opening than the other."

WOUNDS OF THE FACE AND ADJACENT PARTS.

WOUNDS of the face, like those in other parts of the body, consist of incised, contused, punctured, and lacerated.

The ratio of mortality from these wounds is not great, but they are liable to be attended by serious disfiguration and troublesome complications in lesions of the ears, nose, eyes, cheeks, forehead, tongue, jaws, teeth, and mouth, interfering with articulation, mastication, deglutition, hearing, seeing, smelling, glands, and ducts. The causes of mortality in these wounds or injuries may be classed under the heads of secondary hæmorrhage, lodgment of bullets or other missiles in bone, severe strain on the constitution from suppuration, and swallowing fœtid pus and decomposed tissues, inability to take food or masticate, neuralgia, and paralysis; the sufferers in some instances, when the bone becomes permanently diseased, being most wretched and miserable, from the continued fœtid discharge preventing them from joining the society of their fellow-creatures.

All wounds of the face show great aptitude for healing. It is, therefore, best to endeavour, with the least possible delay, to cleanse and approximate the parts, bringing them together with fine sutures, while, when a wound has been inflicted by sharp instruments, and is not deep, the skin only should be included by the silk; but in the event of the cheek being divided into the mouth, the stitches should be somewhat deeper.

Wounds implicating the Bones of the Face.—In the event of bones being cut into, separated, or displaced, they should be readjusted, and, having been cleansed, the skin should be brought over them and stitched, as in the case of an incised wound.

Professor Chisholm gives an account of the plan adopted by medical officers of the Confederate Army in the treatment of wounds of the upper jaw. There was fair result, but much deformity was left in many cases. "Unless the fragments are either completely detached or but slightly adherent, they should not be taken away, but should be replaced with care, as in time consolidation may take place, and very little deformity will be left. Should some of these fragments die, they will be found loose, often as early as the sixth or eighth day, and should be removed. Cold water dressings, with an occasional dose of salts to relieve the excessive swelling, is the only medication required. The wound in the face, after careful adjustment of movable fragments, should be closed with adhesive plaster, and, with the use of cold water dressings for a few days, the ease is left pretty much to Nature."

My experience of wounds of the face during the Crimean War quite concurs with the foregoing, in adjusting and supporting the parts, and in no interference with fragments of bone or teeth unless completely detached.

Wounds of the lower jaw are allowed to be more troublesome than wounds of the upper jaw, and are certainly more numerous. It has been remarked by Dupuytren that they are more dangerous than the upper, but such has not been the case in late campaigns. The great obstacles to be overcome in the treatment of gun-shot wounds and extensive injuries of the lower jaw, are—1st. The difficulty of keeping the bone in proper position, in consequence of its liability to hang down. 2d. The incessant discharge of saliva. 3d. The difficulty of feeding the sufferer.



Fig. 84.

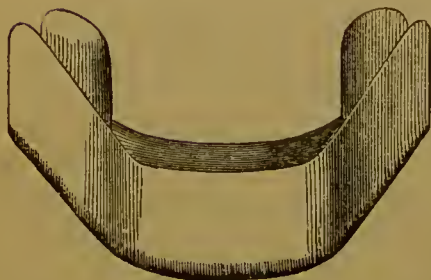


Fig. 85.



Fig. 86.

After a short time suppuration sets in, and the foetid smell (which must be relieved by antiseptics) is intolerable to the patient and his attendants.

Many ingenious contrivances have been invented for keeping the jaw in position, some of which are complicated and expensive.

On service a piece of gutta-percha, about one-eighth of an inch thick, and cut as represented in fig. 84, softened in boiling water, moulded to the jaw as shown in fig. 85, and secured by means of a four-tailed bandage or two

handkerchiefs, as shown in fig. 86, makes a comfortable appliance. It may be lined with soft lint or cotton wool, and should be applied with great care.

If an opportunity offers of securing two fragments of bone by fastening together contiguous teeth, it should be done by means of silver wire or silk.

The adjustment frequently checks hæmorrhage, and prevents further mischief from sharp-pointed spiculæ of bone, which from the hard nature of the lower jaw always exist in gun-shot wounds. The surgeon may not be in possession of gutta-percha, when he may substitute pasteboard, leather, or in fact any substance that can be moulded and give support to the jaw.

Mr. G. E. Hammond, while serving with an ambulance at the siege of Paris, had much success in the treatment of gun-shot fractures of the lower jaw, by means of a framework of iron wire, as represented in fig. 87. He first approximates (temporarily) the broken bones by passing a silk thread between and around two teeth on each side of the fracture ; he then takes

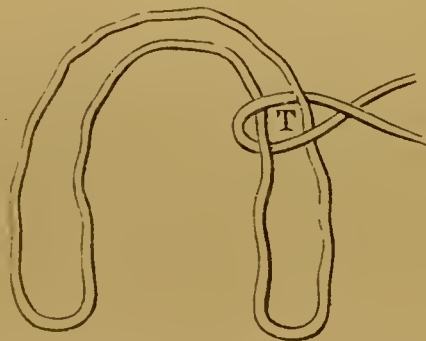


Fig. 87.—Hammond's splint for gun-shot fracture of the lower jaw.

an impression of the teeth in wax, and from it a cast in plaster of Paris. He adjusts the frame on the plaster cast, and when ready places it over the teeth, securing it on either side by wires, as shown in fig. 87. Letter T is intended to represent a tooth. The wires should be cut short, and their ends twisted in between the teeth.

This contrivance renders the jaw comparatively firm, and so solid that the patient can bite steadily on it without pain. The jaw should now be secured at perfect rest. The patient should rinse his mouth four or five times a day with rectified spirits of wine and water, and he should sleep on his side, to allow of a free discharge from the wound and mouth.

Erichsen remarks : " In fractures of the body of the lower jaw by gun-shot injury, there is great comminution and splintering of the bone, followed by copious and fetid discharge, which being swallowed, may

reduce the patient to a state of extreme debility, which may prove fatal. In these cases Dupuytren recommends cutting through the lower lip, the taking away of the splinters, and, if necessary, resection of the bone." At the assault on the Great Redan, 1855, a brother officer of mine received a bullet wound at the ala of the right nostril. The bullet entered the mouth, smashed most of his teeth in the upper and lower jaw, broke in the hard palate, lacerated the tongue extensively, and broke the lower jaw in several places. His condition was that of extreme wretchedness; but by adjustment of the parts as far as possible, removal of splinters, and support by means of the gutta-percha splint, he was made comparatively comfortable. The suppuration was profuse, and the wounds remained open for a considerable period, but he so far recovered as to be able to perform the duties of a field officer, having had a false palate and several teeth adapted to his mouth.

This officer was supported for several days by fluid nourishments administered through a quill passed well back in the mouth.

Fracture or fissure of the symphysis is not difficult of detection. Sir W. Fergusson adopts the following method for keeping the fragments moderately steady:—"I shape two narrow wedges of cork about an inch and a half long, and a quarter thick at the base, and sloping away to a point, one of which has been placed on each side between the teeth; and then I have affixed a wetted and softened piece of pasteboard on the chin, which has next been drawn tightly up, by means of a bandage carried from this part over the crown of the head; as the pasteboard has got dry, a kind of mould has thus been formed on the chin, which has obstructed all future movements so long as it has been kept on. The cork wedges have insured regularity as regards the teeth, and an opening has been left between the incisors, whereby the patient has been fed upon soups and other fluid nourishment. Generally, however, the wedges have become loose, and in the course of ten or fifteen days the patients have become accustomed to restrain the movements of the parts, and without taking particular pains about tightening the bandages afterwards, excellent cures have followed."

The profuse salivation may be relieved by the administration of morphia and saline drinks. The sufferer should be supported by fluid nourishment administered by a tube passed to the back of the mouth, or by a long narrow spoon; indeed, it may sometimes be necessary to support Nature by enemata of beef tea, wine, &c.

Hamilton recommends, when the fœtor is excessive, occasioned by the saliva and pus in the mouth, to use a weak solution of the tincture of myrrh in water. With this the mouth should be rinsed often.

Wounds of the Ear.—The external ear may be shot away, or cut off with a sword, or otherwise injured. Instances have been recorded by Paré and Hildanus, of the ear having been completely detached, and when replaced

healing without any difficulty. Measures should therefore be adopted, on an ear being cut or injured, to replace any pieces, and secure them by means of very fine sutures, taking care to include the outer skin only, and not the cartilage.

Wounds of the orbit include the eyelids, which may be so injured as to cause much loss of tissue, and the after-consequences eversion and inversion.

The eyeball may be so injured as to cause evacuation of the humours, extravasation of blood into the eye (*hæmophthalmia*), protrusion of the iris, lodgment of extraneous substances, causing impairment of vision from amaurosis, cataract, &c.

The bones of the orbit may be injured, and result in inflammation of the brain or its membranes.

Mr. Hennen records a case in which a bullet was lodged in the orbit without causing injury to the eye or the bones; it was removed on the following day by a dressing forceps, was found flattened, and had caused but little irritation to the eye. Such escapes are not often met with.

Bayonets and sharp-pointed weapons perforating the thin orbital plates generally inflict such injury that they are followed by fatal results.

Incised or lacerated wounds of the eyelid and brow should be carefully cleaned, and edges brought together as far as practicable by means of fine sutures, and as quickly after the accident as possible.

Mr. Guthrie suggests a leaden thread as being the best, the first suture being introduced at the very edge of the lid; and two, or as many more afterwards as may be necessary. They may remain for three or more days, as circumstances seem to require.

Wounds of the eyeball may be divided into penetrating and non-penetrating.

The treatment of injuries to the eyeball must be of an antiphlogistic character. When severe, it may be necessary to take blood from the temple or arm, and if the organ is not totally disorganised, the iris should be dilated by the application of sulphate of atropine in solution, and calomel and opium given internally, with a view to subduing inflammation.

Penetrating wounds of the eye must also be treated by antiphlogistic measures, calomel and opium being given, and the sufferer kept in darkness.

Should the iris protrude, an attempt must be made to put it back; but if that cannot be done, it may be snipped off with a pair of fine seissors. In making the attempt to return the tissue, the solution of atropine will greatly assist the operation.

With regard to the lodgment of foreign bodies in the eye, the Surgeon-General of the U.S.A. has expressed an opinion, based on reports of gunshot wounds of the eye during the War of the Rebellion, 1861-65, that: "Whenever foreign bodies are lodged in the eye, they should be extracted at all hazards. If it is impracticable to find them, the globe should be extirpated in order to preserve the other eye."

When general *ophthalmitis* has followed a gun-shot injury, a free horizontal incision, evacuating the contents of the eyeball, should not be long delayed. Also absolute rest and strict diet are required.

In fractures of the bones of the orbital region, it is not judicious to remove fragments, unless they are completely detached, acting as foreign bodies.

Injuries of the Nose.—In cases of incised wounds, the parts must be adjusted, and sutures applied in the same manner as for wounds of the ear, taking care that the skin does not curl in, which would prevent adhesion. Should the nose be broken, it is best to try and place it in its normal position; inserting in the nostrils pieces of gum elastic catheters, or plug with lint or sponge, to preserve the feature or configuration of the organ, and prevent contraction of the nasal passages and depression of the nose. These injuries are frequently complicated with violent epistaxis, which may require plugging of the posterior nares.

Wounds of the Cheeks and Forehead.—These wounds are usually the result of sword or gun-shot, and, when the parts are not completely carried away, will heal most readily if properly adjusted and secured. They have, like wounds of the scalp, the same tendency to attacks of erysipelatous inflammation; it is therefore necessary, during the treatment, to prevent the wound being exposed, and to observe strict dieting and temperance.

No matter how small a shred may be attaching a fragment of skin to the face, an attempt should be made to readjust it.

Wounds of the Parotid Duct and Gland.—Wounds of the cheek may be complicated with injuries of the *parotid duct*, and to prevent a salivary fistula being formed, Mr. Guthrie recommends: "If the duct of the parotid gland be implicated by an incised wound, care should be taken to divide the cheek into the mouth, if it should not have been already done; and to keep the incised wound open until the external one is closed. If a salivary fistula have formed externally, from inattention or otherwise, it must be treated according to the ordinary methods adopted in such cases. When a wound of the gland itself becomes fistulous and weeps, which is a rare occurrence, it will be best treated by actual or potential cauterisation, if moderate pressure should fail."

Injury of the lachrymal bones, or sac, causing the tears to run over, which misfortune may continue for life, should be treated by endeavouring to remove obstructions in the duct, and prevent the distress which must follow from want of early care and attention.

Wounds of the tongue frequently give rise to extensive hæmorrhage, which, if secondary, or occurring several days after receipt of injury, when the process of suppuration is going on, and the tongue is swollen and painful, is difficult to check.

If the bleeding vessels can be discovered, they should be tied, and to do this the tongue must be drawn well forward, or an attempt may be made

to restrain the hæmorrhage with styptics, or it may be necessary to tie the lingual artery.

Wounds of the mouth are generally in connection with wounds of the face ; but they may be still further complicated with injuries to the pharynx, tongue, spinal cord, jaws, and skull.

WOUNDS OF THE NECK.

THE following remarks on the above subject, by Mr. Hennen, are so much to the point, that they may be quoted here with advantage : “ It is only from a consideration of the parts of the neck, as they form one complete and sympathising whole, that we can derive any rational views of the symptoms that may occur from its injuries ; or any satisfactory explanation of them after they have taken place. The close and intimate connection of the great vessels and nerves, and of the canals leading to the thorax and abdomen, are such, that separate views of their affections, however they may carry the appearance of minute accuracy along with them, are more the objects of speculative calculation in the closet, than the result of actual experience, and can seldom be of any practical utility in the field hospital.”

American surgeons subdivide wounds of the neck into wounds of anterior, lateral, and posterior cervical regions ; the anterior being grouped into two lesser divisions, as they are inflicted above and below the hyoid bone. Among them, wounds of the larynx, hyoid bone, trachea, pharynx, and cesophagus. In the lateral regions, lesions of the great vessels of the pneumogastric and sympathetic nerves, and of the chain of lymphatic glands. In the posterior region, occupied by muscles, nerves, vessels, wounds of minor importance compared to the other subdivisions.

Superficial wounds of the neck require the same treatment as elsewhere, the surgeon always bearing in mind the great liability to erysipelas in these parts, rapid diffuse inflammation and infiltration.

Deep wounds of the neck, such as those produced by stabs, may be accompanied by most distressing symptoms, such as oppressed breathing, nausea, spasmodic twitching of face, paralysis of one or both arms, cough, restlessness, and hiccough.

In gun-shot wounds of the neck, it is scarcely possible to have lesion of one important structure without others being implicated ; at the same time it has been generally observed that bullets and other missiles pass in and out between muscles, vessels, and nerves, and even the trachea, without causing much injury to any. This is accounted for by the soft and flexible condition of the structure of the neck offering no resistance.

Wounds of the larger arteries and veins generally prove fatal immediately, but in wounds of the smaller vessels there is frequently much difficulty in

discovering whence the hæmorrhage arises, and what trunk should be tied. Mr. Guthrie quotes, with great satisfaction, the opinion of M. Velpeau on this subject: "In hæmorrhage from the neck, the mouth, the throat, the ear, or the skull, everything should be done to reach the branch of the carotid which has been wounded, rather than tie the carotid itself."

Wounds of the Larynx.—In wounds of the larynx, the parts must be adjusted and kept in contact by bandages, sutures being considered objectionable.

Should a bullet or other missile get into the larynx, it must be removed by operation, and when extensive inflammation is set up, causing infiltration or œdema, it may be necessary to open the trachea, and insert a tube to allow the sufferer to breathe.

An interesting case is given by the Surgeon-General of the American Army, where the larynx became so obstructed after a wound, that it was necessary to open it and prolong the incision as far as the third ring of the trachea; the proceeding was successful.

Should clots of blood get into the larynx or trachea, and they are not coughed up, an endeavour must be made to remove them by sucking, or by means of an exhausting pump.

Wounds in connection with larynx or trachea, or in their vicinity, should not be closed till all hæmorrhage has ceased, for fear of suffocating the patient. These wounds may be accompanied by emphysema, causing much distress, which should be treated by small punctures, if it extends; but as a rule it will pass away when suppuration of the wound commences.

Wounds of the Œsophagus.—For wounds of the œsophagus but little can be done, Nature performing all that is required in healing; and it is sometimes most remarkable how quickly this is effected. Wounds of the œsophagus render the patient unable to swallow, without much discomfort, and in many cases not at all, when it will be necessary to give him nourishment by a gum elastic tube introduced through the nose into the stomach, or by enemas of beef tea, milk, gruel, and other nutritive fluids.

During the Crimean War a complicated case of bullet-wound of the larynx and œsophagus came under my immediate care, the particulars of which may be recorded here: At the assault on the Great Redan, the sufferer having mounted the parapet, and while in the act of reloading on his knees, was shot from below by one of the enemy, who was immediately at the bottom of the parapet. He fell on his side, did not feel much pain, but could not speak. On arrival at the camp hospital, two wounds were found in the neck, the ball entered at pomum Adami and made its exit at the anterior edge of the sterno-mastoid muscle of the right side. There was very little hæmorrhage from either wound, and no displacement of the thyroid cartilage. The patient was suffering from a frequent cough, with bloody expectoration, loss of voice, and nausea; bubbles of air appeared at every

expiration at the wound in the larynx, that of entrance; and when he attempted to drink, some of the fluid came through the wound at the anterior edge of the sterno-mastoid, the wound of exit. This latter symptom continued for five days, and then ceased altogether; for twelve days the air continued to pass through the upper wound and then ceased. The cough during that time was very troublesome; the expectoration being very copious, which caused much loss of rest; during the first six days there was slight emphysema about the upper wound, but it gradually disappeared.

The treatment consisted at first of antiphlogistic remedies, both local and constitutional; and lint wet with cold water was kept constantly to the wound. He was fed by means of a spoon passed very far back, containing arrowroot, milk, or tea; his diet was gradually increased after five days, and he was able to swallow bread softened in tea, rice, and milk; and, as inflammatory symptoms subsided, wine, porter, and nutritious diet were allowed. The wounds healed completely; but the voice was much impaired, being little more than a whisper.

WOUNDS OF THE CHEST.

Classification.—Wounds of the chest are divided into penetrating and non-penetrating.

The non-penetrating may be subdivided into wounds of skin, fascia, and other soft coverings of the walls of thorax, fracture of the clavicle, scapula, sternum, vertebrae, ribs, injury of bones or cartilages, and superficial vessels.

The penetrating may be subdivided into those connected with wounds of pleura, lungs, heart, great vessels, nerves, œsophagus, and thoracic duct.

Non-penetrating wounds may be accompanied by lesions of the internal viscera, from violence, causing contusion or rupture of viscera or an important blood-vessel, and subsequently by inflammation of the pleura or lungs, giving rise to pleuritis or pneumonia, or both.

Non-penetrating wounds of the soft parts alone differ but little from wounds elsewhere, except that they are much slower in healing, due in all probability to the ribs never being at rest, and consequently the lips of incised wounds, for instance, are not kept in apposition.

In dressing these wounds, it is recommended to apply strips of adhesive plaster in such a manner that the ribs may be supported and wounds relieved from strain; this is best accomplished by placing broad strips of plaster at right angles to the ribs, and bandage round the chest with narrow strips of bandage over the shoulders, stitched to that on the chest, with a view to keeping it in position.

Simple fractures of the several bones in connection with the chest, such

as clavicle, scapula, ribs, and sternum, must be treated in accordance with the special principle laid down for these injuries.

In compound fractures of these bones from gun-shot, where the wound does not penetrate, much trouble and anxiety may arise from depressed spiculæ causing inflammatory symptoms and requiring elevation or removal, or giving rise to abscesses or diseased bone.

Wounds of the external arteries of the chest, producing profuse hæmorrhage, should be secured at both ends, as, from the nature of the surrounding tissues, blood is apt to be extravasated or aneurisms formed.

All external wounds, at first apparently trivial, should be most carefully watched for several days, as inflammatory symptoms of the lungs or pleura may arise, and should be checked with the least possible delay.

Penetrating wounds may be complicated, in the first instance, with emphysema, pneumo-thorax, hernia of the lung, hæmo-thorax, and presence of foreign bodies, and subsequently by hydro-thorax, empyema, fistulous openings, and contractions of the chest.

In wounds of the heart and larger vessels, the result is generally immediately fatal; at the same time instances have occurred where a sufferer with a wound of the heart has lived for several days.

Symptoms of Wound of Lungs.—A penetrating wound of the chest may be accompanied by the following symptoms, which, taken as a whole or in connection with one another, may satisfy the surgeon that the lung has been wounded; but they are not proof positive that such is the case, as all may be present, and yet no wound of the lung:—Shock, sudden collapse, or fainting from hæmorrhage, internally or externally; the escape of blood and air through external wound, of pale red colour and frothy; continued issue of blood, mixed with mucus, from mouth during efforts of coughing; emphysema; deeply-fixed pain in the chest; irritation of larynx and spasmodic cough; difficulty of breathing. Shock, sudden collapse, or fainting, may occur with any severe wound. The escape of blood and air through external wound may take place in consequence of a wound of intercostal or mammary artery by air having been drawn into the cavity of the thorax during each expiration, expelled during inspiration, and driven into the blood. The issue of blood from the mouth, mixed with air, is looked upon as satisfactory evidence of wound of lung; but it may arise from other causes unconnected with the wound, and may therefore exist without a lung wound.

Emphysema, which was considered by older surgeons to be proof positive of a wound of the lung, is now looked upon as a complication which may be caused by the admission of air into the chest through the external wound, and not finding ready egress during respiration, passes into the cellular tissue, in the immediate neighbourhood of the external wound, and therefore cannot be considered as a diagnostic symptom of any value.

The pain in the chest, cough, irritation of larynx, and difficulty of breathing, with the continuance of blood in the mouth, or blood, *and especially mucus*, from the wound, may be considered the most reliable symptoms.

When the wounds occur in civil life, the weapon causing the injury might be procured, and a certain amount of assistance afforded by examining it, and judging of its extent by the stains of blood on it ; but in war there is no such help.

It has been recommended to test the wound by holding a lighted candle opposite to it, and direct the patient to take a deep inspiration, when, if the candle is blown upon, it is a proof that the lung has been wounded.

Use of Probes in Chest Wounds.—The introduction of the finger or a probe may afford the desired information ; with the former there may be great difficulty, as the wound may be small, and the space between the ribs not admit of the finger passing. The latter expedient is not considered judicious—in fact, it has been condemned by most competent authorities, and justly so.

Dupuytren considers that a probe ought never to be used in a wound of the lung. It is, he says, the greatest fault that can be committed in surgery, and the instrument called chest-probe that one finds in cases of instruments ought to be banished, at least for this sort of lesions.

Mr. Poland says : “ Exploration by means of the finger, probe, sound, or other instrument, were this to be permitted, and a careful and minute examination made by the introduction of the finger into the wound, an easy diagnosis would at once be realised ; but in wounds of the chest, as in wounds of the abdomen, all manipulative examination is to be denounced as perfectly unwarrantable, being attended with highly dangerous results, by disturbing Nature’s efforts to effect a repair, disarranging the clot, and exciting irritation and inflammation—a proceeding only tending to gratify curiosity, without the slightest benefit to the patient.”

Treatment of Penetrating Wound.—On first seeing a patient with a penetrating wound of the chest, an endeavour should be made to restore animation by the administration of beef-tea and cordials. Should reaction take place, distressing symptoms will cease ; hæmorrhage may have been checked, and with a suitable bandage round the thorax, it is possible no bad symptoms will follow ; but blood may continue to be poured out in the cavity of the chest, causing pressure on the lungs, and consequent symptoms of distress, or it may come through the external wound, flooding the sufferer.

Blood in Cavity of Chest.—If the blood is being poured into the cavity of the chest, the surgeon will be warned by the cold perspiration, the pallid countenance, faintings, the weak pulse, and distress in breathing. If he examines the chest, he will find it enlarged on the injured side, intercostal spaces bulging out.

There will be dulness in proportion to the amount of cavity filled up.

There will be no respiratory murmur, the lung being pressed down. Succussion may afford proof of the presence of blood in the chest.

Ecchymosis is laid down as a symptom or sign of effusion of blood within the chest at a late period. Valentine considers it to be a pathognomonic sign of effusion of blood. He says: "It is very dissimilar to that which occurs after a blow or wound, and which takes place shortly after the accident, being around the wound if there be one, and extending from it. The patient also complains of pain when the bruised part is pressed by the fingers. These characters are not observed in the ecchymosis, the sign of effusion, which always takes place near the angles of the lower or false ribs, descending towards the loins. Its colour is identical with that which appears on the abdomen of persons some time after death—a bright violet (*violet très-éclairci*). It appears about ten days after the receipt of the injury—sometimes later." Should the blood come through the external wound, the diagnosis is simple enough.

Treatment for Hæmorrhage into Cavity of Chest.—It now becomes a matter of serious consideration what is the best line of treatment for this form of hæmorrhage; but before taking it for granted that it is coming from the lungs, an endeavour should be made to try and discover if the intercostal or internal mammary arteries have been wounded. And as a guide to this, it has been remarked that when there is internal hæmorrhage from the latter sources, the symptoms are more gradual than if the blood comes direct from the lungs or pulmonary arteries.

In the event of the hæmorrhage coming from mammary or intercostal arteries, an attempt should be made to tie these vessels, or otherwise close them, for which purpose various plans have been proposed, some of which may be mentioned here:—

Pass a curved needle armed with a ligature, completely round the rib, and compress the wounded artery by means of a pledget placed over orifice and included in ligature.

The employment of agarici or sponge, with continual compression by hands of successive assistants.

Professor Longmore describes "Desault's purse," which is a mode of compression, and is as follows:—"Place a piece of linen on that part of the chest at the wound. The middle portion of the linen is pressed by the finger into the wound, so as to form a kind of pouch. This pouch is then distended with sponge or lint pushed into it, till it arrests the bleeding. On stretching out the corners of this linen cloth, the pressure of the plug will be increased. The whole may be secured to the chest by a roller or bandage."

This method I have used with the most perfect and permanent success, adding to the lint or sponge a little of the solution of perchloride of iron.

Mr. Guthrie considers that wounds of the intercostal arteries rarely give rise to hæmorrhage so as to require a special operation for suppression;

but whenever it does so happen, the wound should be enlarged, so as to show the bleeding orifice, which should be secured by one ligature if distinctly open, and by two if the vessel should only be partially divided. The vessel is sometimes so small as to be easily twisted, or its end sufficiently bruised as well as twisted, to arrest the hæmorrhage.

It having been pretty well ascertained that hæmorrhage is from the lung, and the symptoms being urgent, what measures should the surgeon adopt? Many opinions have been expressed on this important and difficult subject.

Hennen recommends that the surgeon's first object be to diminish the quantity of circulating blood, the quantity removed being governed by the condition of the patient. He says: "If a man is wounded in the chest, let him lie quietly along, and lose from thirty to forty ounces of blood; remove clothes, examine with finger and extract everything within reach, whether cloth, ball, iron, wood, splinters of bone, or clots of blood. If the orifice is not sufficiently large, we must not be afraid of making it moderately larger by a cautious use of a probe pointed bistoury."

If the patient survives the first three days, hopes may begin to be entertained of his recovering the immediate effects of the hæmorrhage; the danger then to be apprehended is not from hæmorrhage, but from inflammation of the lung and pleuritic effusion.

Ballingall says, when hæmorrhage arises from the lungs themselves, we have no efficient means of commanding it, and can only obviate it by general depletion, and thus diminish the quantity of blood passing through the lungs. It must be boldly pushed to the utmost limit.

Mr. Guthrie advocates the following measure:—"The right course is, I apprehend, to remove all the blood which can be evacuated by position, provided it can be done without danger to the patient, rather than to allow it to fill the chest; but as the bleeding vessel in the lung cannot readily be got at, if seen, nor be secured by ligature with advantage, it is advisable, if the bleeding continue, to close the wound, and allow the cavity of the pleura to be filled, until the lung shall be sufficiently compressed to cause the hæmorrhage to cease, if the person survive so long.

"The first object is to save life; after that, if time be given, the next will be to relieve the loaded cavity."

Mr. Longmore recommends that "hæmorrhage from the lung itself must be treated on the general principles adopted in all such cases: the administration of cool acid drinks, ice—if ice can be obtained, perfect quiet, and the administration of opium or digitalis.

"When blood has accumulated in any large quantity, and the patient is so much oppressed as to threaten suffocation, all coverings must be removed, and the blood permitted to escape by wound; the wound should even be enlarged, if necessary, so as, with the assistance of proper position, to facilitate its escape. If the effused blood, from the situation of the wound,

cannot be thus evacuated, and the patient be in danger of suffocation, then paracentesis must be resorted to."

Dr. Macleod, who had considerable experience during the Crimean War, says that those cases did best in which early, active, and repeated bleedings were had recourse to.

Mr. Poland recommends repeated bleeding, with a view to making a sudden impression on the general system.

The Report of the Surgeon-General, American Army, on the treatment of chest wounds during the War of the Rebellion, is of the greatest importance; and from the vast number of cases, amounting to 20,264, the success in the treatment without venesection should be a great lesson to the army surgeon, and enable him to decide as to the proper course to be adopted in such cases.

The following is an abstract of the measures used for the different descriptions of wounds:—

In injuries of the thorax, whether attended or not by breach of surface, rest, a comfortable position, and a broad bandage round the chest.

After stanching the bleeding, cleansing the parts and removing foreign bodies, the further conduct of the surgeon must be governed by the extent and nature of the lesion. All superficial wounds should be closed, with a view to early adhesion. In extensive incisions or lacerations, use sutures or "serre-fines," but in coughing or movements these are apt to be torn out.

In penetrating wounds, some preferred to support the injured side with broad strips of plaster; this was considered a secure dressing, and acceptable to the patient. The starch bandage was used, but its application was not found convenient.

When the discharges were profuse, carded oakum was used.

In profuse primary hæmorrhage the bleeding was arrested, if possible, by ligature or compression, but when impossible to reach the source of the internal bleeding, it was considered best to close the wound and to promote occlusion of the bleeding vessel by general means.

In the general treatment, the uncomplicated non-penetrating wounds required no exceptional measures beyond restriction of diet and the means necessary to insure rest.

In penetrating wounds venesection appears to have been abandoned altogether; hæmorrhage was treated by the application of cold, perfect rest, and the administration of opium.

These measures, he says, seem to have proved adequate generally.

Dr. Chisholm's views are given in the Surgeon-General's Report. He deprecates venesection in chest wounds; even when the lung is inflamed he prefers the mild antiphlogistic and expectant treatment to the spoliative. The large success in the treatment of perforating chest wounds in the Confederate hospitals, puts forth in strong light the powers of Nature to heal

all wounds when least interfered with by meddling surgery. Absolute rest, cooling beverages, moderate nourishment, avoiding over-stimulation, with small doses of tartar emetic, veratrum or digitalis, the liberal use of opium, and attention to internal secretions will be required in all cases ; and in most will compose the entire treatment.

Among the pharmaceutical preparations employed by the American surgeons was opium, which appears to be the one on which most reliance was placed ; but care should be observed in its administration, as hæmorrhage tends to increase its action. It quiets the nervous system, and indirectly moderates hæmorrhage.

Stromeyer, in his "Experiences of Gun-shot Wounds," 1866, remarks, under the head of Wounds of Thorax, that, "with the exception of a single instance of venesection which was at his own suggestion, there was no bleeding for chest-wounds." How far it might have been desirable in exceptional cases, he cannot decide, but adds : "It is assuredly to be deplored if, by omitting bleeding (through the omission of which other things were to be neglected), little attention is paid to the remainder of the treatment." He frequently discontinued wine and coffee, which acted as stimulants, and ordered the patient to take whey, and, later on, cod-liver oil. "It is only through tranquillity and prudent nourishment that the dangers of chest wounds can be avoided."

Legonest objects strongly to bleeding for wounds of lungs, as being more injurious than useful. He thinks it is better to close the wound, have recourse to exterior stimulants, local application of refrigerents or ice. Should hæmorrhage continue in the cavity of the chest, the wound must be opened if closed, and if too small to admit of evacuation of blood it must be enlarged ; should this enfeeble the sufferer, the wound should be reclosed. The patient should lie on the affected side, with a light bandage round the chest.

In former days excessive bleeding for hæmorrhage from the lungs, the result of a wound, was the general and established practice ; but at the present time, and since the Crimean War, quite the opposite method has been and is most in favour ; in all probability due to the exertions of the many distinguished and thoughtful surgeons who served in that war. The course now recommended is to close the wound, allow the cavity of pleura to fill with blood, in view to compression of the wound in lung, and thereby close the vessel ; but should great distress and difficulty of breathing supervene, place the sufferer on the wounded side and allow the blood to come away ; and if the wound is not sufficiently large for this purpose, carefully extend it. Should there be two wounds, the uppermost should be closed.

Ice, refrigerating drinks, dilute sulphuric acid and opium, acetate of lead or ergot, may be administered, the patient being placed in a cool room, with little or no food, and no stimulant whatever. In strong and healthy young soldiers, with great distress of breathing, relief may be afforded by vene-

section, as practised by Dr. (now Sir William) Muir, in the Crimea, assisted by antimony and ipecacuanha, and the consecutive inflammation of lungs or pleura mitigated or obviated.

Pneumonia.—Should inflammation or effusion take place, and the sufferer be attacked with the usual symptoms of pneumonia or pleuritis, it has been recommended (but on this point opinions differ) to resort to bleeding.

Guthrie says : “The first and most essential remedy in the treatment of pleuritis and pneumonia from injury is bleeding, which should be resorted to in every case, whenever the febrile excitement is really inflammatory. All old people, under such circumstances, unless in a cachectic state, bear at least one bleeding well ; they often bear more, and no fact is more important, in opposition to the opinions commonly entertained on this subject. In young people, who have not been reduced in health and strength by privations and hard service, the bleeding should be repeated until the desired object has been effected ; the quantity required to be drawn in inflammation, particularly after injuries, is very great. It may almost become a question, in some cases, whether a patient shall be allowed to die of the disease, or from loss of blood ; for convalescence is rapid in proportion as the inflammation is of small extent, and has been early subdued.

“Bleeding in inflammation of the pleura, in *young and healthy* persons, should therefore be effected with an unsparing hand, until an impression has been made on the system—until the pain and the difficulty of breathing have been removed—until the patient can draw a full breath, or faints ; and the operation should be repeated, from time to time, every three or four hours, according to the intensity of the recurrence, or the persistence of the essential symptoms.”

Dr. Fraser, in his work on wounds of the chest, endeavours to point out the inutility of blood-letting for wounds of the lung, and subsequent inflammation. He remarks : “Inflammation, as the term is generally understood, is a most rare event in lung wounds ; and consequently venesection is uncalled for, often injurious, and sometimes dangerous.”

The cases which demand bleeding are those in which the pulse conveys to the finger of the medical man the sensation of a full, labouring, and oppressed pulse. The experience of the writer is that soldiers, when campaigning, can ill spare blood, especially if much has been lost from a wound or wounds ; he therefore considers that the administration of antimony and a strict observance of diet and temperance, warm applications to the chest, will reduce the inflammation, if it is to be done at all.

In civil life, Mr. Erichsen observes, that in healthy subjects, if inflammation be confined to the lungs, and attended by much dyspnoea, venesection will often give much relief. The army surgeon may therefore class young soldiers at the beginning of a campaign with the patients alluded to by Mr. Erichsen.

Gun-shot Wounds of both Lungs.—With regard to the effects of a gun-

shot wound of both lungs, many cases have been reported of recovery when both lungs have been penetrated, and dissection has proved that sufferers have lived for several days ; but the probability is, that health will never be permanently restored after such an accident.

Hermetically sealing penetrating wounds of the chest was proposed by Assistant-Surgeon B. Howard, U.S. Army, but the process does not appear to have been approved of by the surgeon-general, or other military surgeons. The former considers the indiscriminate application pernicious. Mr. Howard's plan is as follows :—

“Clean the wounds of all clots, splinters, and extraneous matters ; pare the edges and retain them in accurate apposition by means of metallic sutures ; carefully dry the wound and parts immediately surrounding it ; place thereon a few shreds of charpie arranged crosswise, after the manner of warp and woof ; pour on the charpie a few drops of collodion, so as to saturate it and form a sort of collodion cloth ; let it dry, then apply one or two additional coats of collodion with a camel's hair pencil, and repeat the process, until satisfied that the wound is hermetically sealed.”

On the plan of hermetically closing wounds, Surgeon-General Gordon remarks, with regard to its application during the siege of Paris :—

“It is true that the method of treating gun-shot wounds of the chest, as practised by Dr. Swinburne, and followed by Dr. Howard in the American War, is condemned by some surgeons. It is beyond question, however, that the results obtained from it in the ambulance in the Avenue de l'Impératrice during the siege were very satisfactory, so far as they went, and of a kind to justify its further adoption. It seems to me, therefore, that in future wars the treatment indicated is this :—Provided the bullet passes completely through the chest, close the opening as Dr. Swinburne did, and so treat the patient. However, from accumulation of fluid or subsequent suppuration, not only may it become necessary to allow the contents of the pleura free egress by the original wounds, but openings in dependent positions may have to be made with a view to give egress to the discharges.”

Extraneous bodies in superficial chest wounds should be carefully removed, and splinters and spiculæ of bone elevated or removed, if detached. In the event of a ball passing through or round the chest, but not having sufficient velocity to make an exit at the opposite side, being possibly impacted between two ribs, or fracturing a rib, and presenting itself as a small tumour under the skin, it will be necessary to observe great caution in attempting to remove it, as by want of care it may be forced back and fall into the cavity of pleura, complicating matters very considerably ; but if it is not causing distress, it is better not to interfere, as the missile may become encysted. The operation should be performed during inspiration.

When round bullets were used, it was not an uncommon circumstance for

a ball to strike a rib and pass half way round the chest, but with the conoidal bullet this rarely happens.

Extraneous bodies in the cavity of the pleura generally give rise to fatal results, but cases are on record where extraneous bodies have been removed, and life of patient saved. The following circumstance may assist in forming a diagnosis as to the presence of such. A wound in chest wall, entering cavity without a wound of exit; lung not wounded; inflammation rapidly set up; auscultation or percussion—the latter should point out the exact position. Guthrie considers that “the presence of a ball, rolling about on the diaphragm, can now be ascertained by means of the stethoscope at an early period, so as to admit of an operation being undertaken with confidence for its removal; whilst the knowledge acquired by auscultation or percussion, of the filling of the chest by fluid, whether serous, bloody, or purulent, is at the same time incontestably demonstrated.

“The presence of a ball, or of any other foreign body, decides the question as to the place where the opening into the chest should be made for its removal.”

Searching for Extraneous Bodies in Chest.—Authorities differ as to the advisability or otherwise of searching for extraneous bodies in the cavity of the chest. Bell, writing in 1800, says, “As for a ball itself, if it be lost in the thorax it is irrecoverably lost, and no method that we can contrive will enable us either to find it or extract it.” With the present advanced knowledge of the science and art of surgery, there is little doubt but that a ball or other missile can be found in the chest, but the propriety of searching for it has not been advocated by many eminent authorities.

Baudens advises the introduction into the thorax, by the open wound where the projectile entered, of a probe, to ascertain the position of the extraneous substance. When that is reached, the point of the probe should be pressed down against the side of the chest, so as to point out its position, and an incision should then be made at the most convenient place.

M. Legouest, in speaking of the use of the probe, remarks: “The only inconvenience to which one is exposed in probing a gun-shot wound of the chest, supposing a foreign body to be in it, is not to find that for which one is searching. In fact, when the lung is free from adhesions it recedes with the pressure of the probe, and escapes injury; or if the lung adheres to the pleura costalis, and the internal wound is in relation with the outer, in this case a chest probe or large gum elastic probe might be introduced into the course of the wounded lung without running the risk of causing more inflammation than the presence of the ball, splinters, clothing, or other extraneous matters.” He agrees with Ledran that, if one is fortunate enough to find the extraneous matter in the lung, one must dilate sufficiently the exterior wound in order to seize it with pincers and extract without obstruction.

Erichsen remarks on the subject of foreign bodies in the chest: “If any

extraneous body, such as a bullet, a piece of wadding, or of clothing, have penetrated too deeply into the chest to be readily extracted through the external opening, it would not be safe to make incisions or exploratory researches, with a view to extracting it, for though its presence would increase the patient's danger, yet attempts at extraction would not only add to this, but would in all probability be fatal. In many cases bodies so lodged become surrounded by an abscess, are loosened, and eventually are spat up, or appear at the external wound."

Emphysema, or the infiltration of air into the cellular tissue, is not a usual accompaniment of some wounds of the chest. It may be caused by a spicula of a broken rib penetrating the pleura and wounding the lung, or by wounds of the lung or bronchi, where air passes from lung into cavity of chest, and is forced into external wound; but to secure its taking place in this latter description of injury, it is necessary that the external wound and wound of lung should not exactly correspond, but have an oblique direction.

It may also be caused by air entering the chest on inspiration through an external wound, and finding some obstruction on being forced out again at expiration, diffusing itself into the cellular tissue.

Mr. Hennen's experience of this complication was that it occurred in about one in fifty cases of wounds of the chest, and that it is more frequent in confined punctured wounds than in those which are free and open.

Mr. Guthrie is of opinion that it is not so frequent an occurrence as was at one time supposed. He says: "An opening made by a musket-ball rarely admits of emphysema. A slanting wound made by a pistol-ball may sometimes give rise to it. After a long tortuous wound made by swords or lances, it is seen more frequently, but then it takes place shortly after receipt of injury."

Legouest considers it one of the most frequent accompaniments of piercing wounds of the chest.

Emphysema appears in some slight injuries, as, for instance, a fractured rib. When a small spicula of bone has penetrated lung, causing emphysema in the immediate neighbourhood of wound, the air will in all probability be soon absorbed by the application of a bandage, or wide strips of plaster round the chest. While serving in India, the writer was called upon to visit a brother officer who had been thrown from his horse and fractured three ribs. He was scarcely able to breathe; there was great pain and considerable emphysema in the immediate vicinity of the broken ribs. A bandage was applied pretty firmly round the chest, when distress in breathing disappeared, and the emphysema subsided in a few days.

Bandaging and strapping must be regulated by the sensations of the patient; and, should either cause distress, it must be at once removed.

Should the swelling extend, so as to interfere with respiration, the

external wound, if there be one, should be opened, and punctures or scarification made in the cellular tissue.

If emphysema is produced by the air being drawn into the cavity of chest through a wound, and then forced into the cellular tissue, the wound should be closed.

In penetrating wound of lung, when the external wound and that in lung are not opposite to one another, the outer wound should be made to correspond with the inner. Larrey recommends incisions, followed by the application of cupping glasses.

Legouest says, that when emphysema is considerable recourse must be had, as recommended by Malgaigne, to making numerous punctures in different places with the lancet, long and deep incisions being useless; the air escapes easily and spontaneously by small incisions, its exit being favoured by depressants.

The application of scarificators and cupping glasses may be useful; but they will draw a certain quantity of blood as well as air, which may not be necessary. Should there be pulmonary congestion as well as emphysema, relief may be obtained by venesection and the administration of ipecacuanha and antimony.

Pneumothorax, or an accumulation of air in the cavity of the pleura, gives rise to the following symptoms: dyspnœa, tympanitic resonance of chest, amphoric respiration, metallic tinkling on auscultation, affected side dilated. The patient feels relief by lying on his back or affected side, seldom on the sound side.

Relief must be given by reopening the wound in chest, if one exists, or removing the air by trochar and canula.

Hæmothorax.—The accumulation of a large quantity of blood in the thorax, giving rise to alarming symptoms, is frequently met with in gun-shot wounds of the chest. Paracentesis may be performed for its evacuation; but as Mr. Bryant well remarks, “to let out blood with a trochar and canula is always a difficult task, and often an impossible one, on account of the coagulum. It would probably be a better operation to make an incision in the thorax where no wound previously existed, or enlarge a small one.”

Hydrothorax may occur as the result of constitutional dropsy or gun-shot wounds. It requires surgical interference, as in empyema; the operation of paracentesis thoracis being necessary. Its presence is recognised by those general signs which indicate the presence of pus or blood in the cavities of the pleura. Hamilton says, it may be distinguished from hæmothorax in being preceded usually by the sign of pleuritis or of pleuropneumonia, in the absence of those symptoms of prostration which must necessarily accompany large bleedings, and in the greater facility with which the contained fluid flows from one point of the cavity to another on change of position.

Empyema.—This condition is the result of high inflammation of the pleura, especially if the constitution is weak; or, from the lodgment of a foreign body or blood in the cavity of the pleura, giving rise to inflammation. It may occur as a collection of serum or pus mixed with lymph and blood. It is to be recognised by dulness on percussion where the fluid has collected; by dyspnoea or difficulty of breathing, absence of respiratory murmur at the lower and posterior part of the chest corresponding to where the fluid has reached the pleural cavity. These symptoms are all influenced by the position of the patient.

There may be *egophony* at the upper part of the lung.

If the effused fluid has filled one side, that side is enlarged; the ribs are immovable and partly raised; the intercostal spaces will be more or less filled up, and the surface of the chest will be found smooth. There will be absence of all breath or voice sounds.

The lung may become pressed against the spine, and, if the left pleura be filled, displacement of the heart may take place to the right side; or, if the effusion is to the right side, the liver may be pushed down below its normal level.

There may be cedema of the back, which was looked upon by the older writers as distinctive of effusion into the chest. There may be cough, but it has no characteristic feature in connection with empyema.

Should the application of counter-irritants and general improvement in health not relieve the patient, the fluid must be relieved by an operation. This in olden time was done with the knife, hot iron, or caustic; and until recently the operation was performed with the trochar and canula originally recommended by Ambrose Paré. But now there is a more convenient and admirably adapted instrument in Dr. G. Dieulafoy's aspirator, whereby fluids can be removed from the chest, liver, or elsewhere without the possibility of air reaching the seat of disease. I have had several opportunities of witnessing the removal of large quantities of pus from the chest with this instrument, when not the slightest unpleasant symptom followed.

Place of Election for Tapping the Chest. Paracentesis Thoracis.—All practical surgeons agree that the operation should be performed between the fifth and sixth ribs, counting from above, and between the sixth and seventh from below, and at one-third the distance from the spinous process of the vertebra, or two-thirds from the middle of the sternum.

When an external swelling indicates the presence of matter which may be the result of inflammation, induced by the lodgment of a ball or extraneous body in the chest, an opening should be made into the tumour, which is called the "operation of necessity."

In introducing the point of the trochar, with which the aspirator is adapted, care must be taken not to wound the intercostal artery; it is therefore best to keep the point of the instrument nearer the lower than

the upper rib, and to press it forward rather quickly so as to avoid pushing the pleura before it.

The admission of air into the cavity of the pleura should be prevented if possible, as in unhealthy constitutions it may give rise to great mischief. If, however, it should find its way in, which it does in most cases where Dieulafoy's aspirator has not been used, the wound should be kept well closed, and the air will in all probability be absorbed.

With regard to injecting stimulating or simple fluids into the cavity of the chest, warm milk or water has been recommended, particularly when foreign bodies have been keeping up irritation, which may be brought to the opening by sudden removal of fluid.

When the fluid is purulent, a permanent drain should be established. This may not take place till after the operation for removal of serum has been repeated several times.

Hennen remarks, "If the symptoms of effusion of purulent matter succeed the original wound within a short period, the site of the injury, as chosen by some surgeons, is the most proper point of puncture. If the empyema is formed at a more distant period, the spot of election, as it is called, or between the sixth and seventh true ribs, is preferred. I should recommend a point considerably below the original wound, as adhesions, either general or partial, are apt to form in its neighbourhood. I have observed great relief to follow this operation; but I have also seen a removal of all the pulmonic symptoms take place, and death very frequently ensue, shortly after the puncture. Nature sometimes makes an effort for the removal of the fluids effused in cases of empyema, by distant channels; but the instances are rare and not often successful."

Hernia of the Lung or Pneumocoele.—This complication may occur immediately after receipt of injury, while the chest wound is open or when it has healed. This latter is a rare occurrence, but may take place when the intercostals have been much injured and weakened. It has been known to occur from fractured ribs, without any wound, the pleura and intercostal muscles having been ruptured. This description of hernia should be treated by supports, the tumour having been pushed back. When there is an extensive wound of the chest, it may occur by violent efforts in coughing or in expiration.

The tumour presents a livid appearance, and if not soon returned will become gangrenous. It is resonant on percussion, and if a stethoscope is applied to it a crackling or rubbing sound will be heard. It may be removed by the knife or by ligature, or, if small, may be returned, provided it has not been strangulated.

Mr. Guthrie recommends: "It should be allowed to remain, or be only so far returned, if it can be so managed, as to rest within the edges of the divided pleura, and fill up the gap made by the incision, over which the

integuments should be accurately drawn and retained. The adhesion of the lung to the pleura costalis arrests the inflammation, and may prevent its progress in other parts of the cavity.

"Whenever the protruded lung has been completely returned, more inflammation has followed than where it has been allowed to remain under the precautions recommended. The protruded lung, when left uncovered and unprotected, soon loses its natural brilliancy, dies quickly, shrinks, and becomes livid, without being gangrenous. In such cases, the protruded part may be removed; but it should never be separated at its base from its attachment to the pleura costalis by which it is surrounded."

M. Legouest recommends that the tumour be allowed to fall off, and he advises dressing in the ordinary manner, protecting the parts from injury, and preventing inflammation. Above all, to repair the lesions which have favoured the formation of the rupture.

Wounds of the Pericardium or Heart.—These injuries may occur from severe blows on the chest, by puncture, stab, or gun-shot. The pericardium may be injured, and the heart escape.

When the pericardium is injured, the patient appears in a state of collapse, or death takes place immediately. The former is usually followed by inflammation, oppression, dyspnoea, great appearance of distress, small pulse, and pain at the seat of injury. The wound should be closed, if large; the sufferer kept perfectly quiet, and strict antiphlogistic treatment enforced.

Wounds of the Heart.—When the heart is wounded, the injuries may not penetrate into the cavities. Instances have been known where foreign bodies have lodged and become encysted in the structures of the organ.

In penetrating wounds the results have been immediately fatal from loss of blood and shock, but sufferers have lain for several days in consequence of the wound closing by contraction, or the lodgment of a coagulum preventing effusion of blood into the pericardium or pleura.

"It is recorded that in cases which immediately prove fatal, the wounded man appears to spring off the ground, or falls dead without convulsion or apparent knowledge of being injured. If the injury does not prove fatal immediately, there will be collapse, followed by great distress and oppression of breathing, anxious countenance, pulse very weak, pallid face. Subsequently there may be all the complications of inflammation of the endocardium.

"The external wound should be accurately closed and all escape of blood prevented, provided, in doing so, suffocation is not induced by blood filling the cavity of the pericardium or pleura, in which case relief may be obtained by allowing some blood to escape."

Inflammatory symptoms should be treated by local bleeding and internal administration of mercury. It has been recommended by Larrey to open

the pericardium, in the event of it becoming full of blood or serum preventing the movements of the heart, by the following operation :—

“An oblique incision is to be made from over the edge of the ensiform cartilage to the united extremities of the cartilages of the seventh and eighth ribs. The cellular tissue being divided with some fibres of the rectus and external oblique muscles, there remains only a portion of the peritoneum, called its false layer, above the pericardium, which can be seen after the division of all the intervening cellular tissue, projecting between the first and second digitations of the diaphragm. Into this the bistoury is to be entered, with the precaution of turning its edge upwards, and directed a little from right to left, to avoid the peritoneum. The smallest portion possible of the anterior border of the diaphragm is next to be divided, where it is attached to the inner part of the cartilage of the seventh rib; the internal mammary artery is to the outside. The patient should be placed perpendicularly, and supported on his bed, which inclines the anterior part and base of the pericardium to the fore-part of the chest.”*

“Skielderup recommends this operation to be done by first trepanning the sternum a little below the spot where the cartilage of the fifth rib is united to that bone, at which part the periosteum lining it offers considerable resistance, and should not be divided by the trephine. Below this there is a triangular space formed by the separation of the layers of the mediastinum, free from cellular tissue, and tending a little more to the left than to the right.”

Wounds of the Diaphragm.—John Bell, in speaking of these wounds, remarks : “Though wounds of the diaphragm are not material in themselves, yet the diaphragm can hardly be touched but in mortal wounds, *i.e.*, wounds touching both cavities, viz., of the thorax and of the abdomen, when most frequently the stomach, lungs, pericardium, or heart, are either wounded or are soon inflamed, and so drawn into disease.”

The surgeon may recognise these wounds, first by the position of the injury in either chest or abdomen, and if there are evidences of a missile or weapon having penetrated; also by the following symptoms—hiccough, spasmodic or jerking breathing, pain in the top of shoulder, or loss of power in the arm. There may be nausea or vomiting, and if the liver has been injured, jaundice may occur. If the stomach or intestines have been wounded, blood will, in all probability, appear, either by vomiting or in the stools.

“A wound of the diaphragm may give rise to a hernia in the chest; it will, therefore, be necessary for the sufferer to remain in the upright position during the process of recovery, to avoid bending as much as possible; and, in the event of recovery taking place, care should be observed in eating small quantities and standing erect after meals, avoiding bending

* Guthrie's “Commentaries,” p. 512.

or straining, as a wound of the diaphragm is supposed never to close except under rare and peculiar circumstances. A patient, therefore, once wounded through that muscle would always be liable to hernia."

Hennen says: "Of the wounds of the diaphragm, I have never met one unconnected with injuries of one or both cavities which it divides, or in which symptoms of their being affected did not appear; although I have met with one instance where a musket-ball passed along from the sternal to the vertebral connection of that septum, precisely following the curvature of the ribs. The prevention of inflammation is the leading indication of cure; but injuries are frequently found on dissection, which were not at all indicated during life by any peculiar symptom."

An operation for the relief of this hernia has been proposed by Guthrie, which, though formidable, he says cannot be compared as to danger with the incision of 12 or 14 inches long through the walls of the abdomen, which has been in some instances successfully made for the removal of diseased ovaria.

The opening should be a straight incision through the wall of the abdomen, large enough to admit the hand immediately over the part where the diaphragm is supposed to be injured. It should be closed by a continuous suture throughout the skin.

The secondary causes of death after lung wounds may arise from hæmorrhage, pneumonia, pleuritis, bronchitis, suppuration of lung tissue resembling phthisis, empyema, pyæmia, gangrene of the lung, tetanus.

WOUNDS OF THE ABDOMEN.

Classification of Wounds of the Abdomen.—These wounds are usually divided into penetrating and non-penetrating, but some authors divide them into wounds affecting the walls, wounds extending into the cavity, and wounds or injuries of contents of abdomen. For convenience of description the former is no doubt the best.

The danger to be contended with in all wounds of the abdomen is peritonitis; and of course, the greater extent of injury, especially internal, the greater probability of this formidable complication.

The prognosis of wounds of the abdomen is very unfavourable, the diagnosis very obscure, and the results of treatment discouraging. Every abdominal wound should therefore be treated as if it were serious until time declares its true nature.

Non-penetrating wounds, uncomplicated, without injury of the internal viscera, require no special line of treatment. If there are incisions or lacerations, the parts should be adjusted and kept in position by means of sutures or stitches, which, according to Guthrie and Tripler, should be introduced

through the integument only ; but the experience of the American War of the Rebellion attests the utility of deep sutures which prevented ventral protrusions by exact coaptation of the divided muscular tissues. The quilled suture appears to have answered the best purpose (fig. 88). In adopting this suture it is recommended to tie the threads in a bow-knot, or to leave the ends long if wire is used, in order to loosen the stitches when inflammatory swelling requires it. The sutures should be allowed to remain until the fourth or fifth day, and the loop of each double thread then being cut, the pieces should be withdrawn simultaneously in opposite directions. The position of the sufferer during treatment should be such that muscles of the abdomen are relaxed by elevating the shoulders and head and flexing the lower limbs.



Fig. 88.—Application of the quilled suture to an incised wound.

A bullet may strike the abdomen obliquely and pass between the muscles and the skin, or between the peritoneum and the muscles, giving rise to alarming symptoms, causing violent pain, vomiting, and general derangement, such as prolonged collapse, followed by extensive peritonitis or suppuration.

In the event of suppuration, an early opening should be made to prevent the possibility of pus perforating the peritoneum.

Should a bullet or other missile be lodged deeply in the abdominal walls, Guthrie suggests that it is often better left alone, unless it prove troublesome. This, according to the extensive experience of Mr. Otis, "is unsound ;" he

considers there are no other exceptions to the general rule of extracting foreign bodies, than the instances in which they are so situated in vital organs that their extraction may immediately jeopardise life. It is, he says, especially important to extract them from the abdominal walls, as they present a constant source of danger while they remain.

Complicated non-penetrating wounds, the result of contusion, may be accompanied by extensive injuries to some of the viscera or bones, and are generally the result of wind-balls, explosions, blows, falls, kicks from men or horses, or the passage of the wheel of an artillery-waggon or gun-carriage over the body. Death may result in a very short time from shock, or hæmorrhage, or peritonitis, or subsequently from sloughing or abscesses in the abdominal walls. The shock in these cases is of the severest description, amounting in some instances to prolonged collapse. The writer on a recent occasion saw an instance of an artilleryman being thrown from the limber while in rapid motion, a wheel passing obliquely over the abdomen and pelvis; he was immediately attacked by prolonged collapse, vomiting, pains, bloody urine, and great restlessness, from which he never rallied, and expired in a few hours. The post-mortem examination gave evidence of extensive hæmorrhage into the peritoneal cavity, it being full of large clots. There was a fracture of the left ramus of the ischium and pubes. There was no external wound of any consequence, the skin being only a little congested where the wheel had passed over it.

Ruptures of the liver are by no means speedily or even necessarily fatal; they may be and usually are so from great extravasation of blood or bile, but when this is not largely poured out, the patient may live for a considerable period, though he may eventually succumb to traumatic peritonitis.

Pain, collapse, hæmorrhage, dulness on percussion, bilious vomiting, followed by peritonitis, white stools, jaundice, and saccharine diabetes, are the symptoms usually ascribed to rupture of the liver; only the three latter are characteristic.

Rupture of the gall bladder is always fatal.

Rupture of the Spleen.—Next to the liver this viscus is represented as the most frequently lacerated of the abdominal organs, but such cases are by no means always fatal. Extended lacerations are followed by profuse internal hæmorrhage, severe shock to the system, coldness of the surface, great anxiety, pain in the seat of injury, and death.

Rupture of the Kidney, though well protected by its position in the loins, is not an infrequent accident. The symptoms usually present are, excessive collapse, pain referred to the lumbar region, retraction of testicle, and very likely pain in the testicle itself and low down in the abdomen; numbness in the upper part of thigh, bloody urine, frequent desire to pass water, and (should the patient survive) there will, in all probability, be infiltration or extravasation into the subserous cellular

tissue, which is more likely to occur in injuries to the posterior surface, and peritonitis in injuries of anterior surface. Infiltration is soon followed by suppurative inflammation, recognised by rigors, fever, dry brown tongue, and oedema of the parts in the neighbourhood of the wounded kidney. Should the kidney be severely contused there will in all probability be albuminuria.

Rupture of the stomach generally proves fatal from the shock alone or irrecoverable collapse. The extent of laceration, the contents, and degree of repletion of the organ at the time of rupture, influence the result.

Should life be prolonged, the sufferer will complain of acute and constant pain radiating from the seat of injury. Hæmatemesis is a constant symptom, followed rapidly by peritonitis.

Rupture of the intestines, both of large and small, may be recognised, as remarks Jobert, by sudden and excessive meteorism, produced by the escape of intestinal flatus into the peritoneal cavity, but this symptom is regarded by others as not being uniformly present in intestinal rupture. Should the patient live long enough, the stools will be mixed with blood, the shock and collapse will be very great; but there will be difficulty in identifying the particular part injured. The part struck will, however, be an assistance in pointing out the seat of mischief.

Emphysema of the abdominal wall may result from rupture of the intestine (with adhesion to the walls), the result of escape of flatus from the wounded intestine. This symptom is characterised by an inelastic, doughy, puffy, crepitating swelling of the cellular tissue. In wounds which to all appearance are non-penetrating, or where there is no protrusion, this symptom is considered to be valuable in proving the existence of wound of the intestine.

Rupture of the diaphragm is very difficult to diagnose. It is generally complicated, and usually with hernia of the abdominal contents into the thorax. Excessive thirst, according to Dr. Wilks and Mr. Bryant, appears to be a most prominent symptom in such injuries. This injury can only occur on the left side.

Rupture of Blood-vessels.—Some examples of lesions of the larger arteries or veins, without the rupture of viscera, have been recorded.

Treatment.—In the general treatment of these injuries, the first step should be to try and restore the sufferer from the shock and collapse by keeping him very quiet, applying warmth to the extremities, and placing him in a comfortable position. Absolute rest should then be enforced, the patient not being moved or allowed to move himself. Caution should be observed in the employment of restoratives and stimulants, in consequence of their liability to cause too much reaction and induce internal hæmorrhage or peritonitis. The bladder should be evacuated with a catheter if necessary, and opium administered in moderate or full doses, according to circumstances,

it being well to keep the patient under its influence for several days. The hypodermic introduction of morphia may be here used with advantage. Milk diet should be allowed, all food being given cold and in small quantities, and indeed in some cases it may be necessary to almost starve the patient.

Aperients should on no account be given till the inflammatory symptoms have subsided, and then only the mildest laxative enemata.

In rupture of the stomach, food, drink, or medicines by the mouth should be absolutely prohibited. Bandages, ice poultices, warmth to the surface, leeches over the seat of pain, and subsequently counter irritation by blisters, have been strongly advocated as circumstances may suggest.

Penetrating wounds of the abdomen, with or without protrusion or injury of the viscera, are serious, whether incised, lacerated, punctured, or gunshot.

Penetrating Wounds without Visceral Injury.—With a small wound, such as from a bayonet or stab, it may be difficult to decide as to the existence or not of an internal injury; the surgeon should therefore be most careful not to introduce probes or other explorers, as he may inadvertently produce a most serious complication, and form a simple wound into one of great severity, as it has been proved beyond doubt that there may be deep penetration or even transfixion of the abdominal cavity without visceral lesion, the foreign body gliding between the smooth and movable organs. It is recommended that these injuries should be treated *with light dressings*, so as to permit of oozing, rather than apply pressure and cause extravasation among the deeper tissues. The sufferer should be on the lightest diet and without stimulants; absolute rest is essential.

Should there be hæmorrhage of severe nature and the wound not sufficiently large to allow the bleeding mouth of the vessel to be seen, Mr. Pollock recommends that the wound be enlarged until the wounded vessel can be seen and can be secured. Pressure should never be applied for checking hæmorrhage in superficial or deep abdominal wounds, on account of the blood being liable to find its way to the cavity of the abdomen or between the muscles and fasciæ, giving rise to deep-seated inflammation and suppuration.

Penetrating wounds with injury of viscera will be attended by great prostration, frequent vomiting, possibly of blood, anxiety, restlessness, and if the sufferer survive, in all probability peritonitis.

In endeavouring to form an opinion as to the part injured, the surgeon will find much help from collateral evidence; thus, the size of the instrument that inflicted it (if possible), position and direction of wound, and character of any stains which may appear on the wound or clothing.

Wounds of the liver may consist of slight groovings or divisions of the peritoneal investiments only; penetrations with a single outlet; long

perforations ; extended lacerations ; lacerations with protrusion ; wounds, complicated by the presence of splinters from ribs, of fragments of clothing, of balls, and other foreign bodies.

If patients escape the early danger of hæmorrhage they are liable to die of traumatic peritonitis, or from abscesses of the hepatic parenchyma. At the same time, serious injuries of the liver are not necessarily fatal. When a portion of the lacerated liver-substance protrudes at the external wound, it may be safely removed by ligature.*

Wounds of the Spleen.—It would appear that the spleen is less liable to wounds than the liver, due to its smaller size and deep situation. M. Legouest mentions that while mortal hæmorrhage or peritonitis sometimes results from lacerations, in some grave cases complete separation ensues. Protrusion is considered a favourable complication, the dangers of internal hæmorrhage and of peritonitis being apparently notably diminished.

In punctured wounds of the spleen it is best to place the patient on the injured side, and endeavour to avert the internal effusion of blood and consecutive inflammation by immobility. Mr. Otis recommends iced drinks, which should, he says, be of benefit, both by distending the stomach and compressing the spleen, and by directly inducing contraction of the spleen.

Wounds of the kidney are frequently associated with wounds of the liver, spleen, diaphragm, stomach, intestines, or spine. Punctured and incised wounds are uncommon, though shot wounds are not very infrequent. These wounds are very dangerous, but not necessarily mortal ; unless the peritoneum is also wounded, and urine escapes into the cavity of the belly, when fatal peritonitis is almost inevitable.

When the kidney has become protruded it may be removed, as evidenced by a case reported by Surgeon-Major M. Marvaud of an Algerian regiment, in which an Algerian woman who had been severely wounded in the lumbar region, where the kidney was drawn out of the wound, between the lips of which it remained strangulated. A silk ligature was passed around the pedicle of the extruded organ, and at the end of some weeks the kidney was separated. After two months she was discharged well.

Wounds of the stomach may be recognised by the position of the wound, its depth and direction, the escape of food or drink, vomiting of blood, pain, faintness, thirst, singultus, tympanitis, pallor, cold extremities. The extravasation of the contents of the stomach is probably the only pathognomic sign of the division of its walls. Much difference of opinion exists as to the proper rules of practice in punctured wounds of the stomach, *even when it protrudes* at the external wound. Sir Astley Cooper recommends that if the puncture is small, the lips of the opening should be pinched up with a pair of forceps, and a thread tied round it. If the opening is some-

* "The Medical and Surgical History of the War of the Rebellion," part ii. vol. ii., p. 147.

what larger, it is recommended it should be closed with the interrupted suture by means of a delicate needle and fine thread. In more extensive wounds, the continued suture, or one of its numerous modifications, may be applied. The danger of a wound of the stomach, remarks Mr. Pollock, is greatly lessened when its contents are observed to escape externally.

The treatment must depend on symptoms; no interference should be permitted with the external wound, if the contents are passing through it. The stomach should be kept empty, and the patient nourished entirely by enemata of beef tea or soup. If there be no evidence of escape of the contents, but if it be suspected that the latter have passed into the peritoneum, as evidenced by the severity of the pain and other symptoms, no treatment is available to save life; and in such a case we have only to endeavour to mitigate suffering. Instances have occurred of wounds of the stomach terminating in gastric fistulæ.

Protrusion of the Intestine.—If the wound in the abdomen has been made by a cutting or lacerating instrument, or by a round ball or rifle bullet, it is generally followed by protrusion of some portion of the contents of the abdomen, the omentum, mesentery, or intestine being most usual. The protruded mass is always very large in comparison with the aperture from which it escapes, and is contracted very tightly by the lips of the wound. If left unreduced, the mass will soon become gangrenous from pressure; it should therefore be cleansed, if soiled, and returned into the cavity of the abdomen, after which the wound is to be closed by sutures which should include the peritoneum as well as other tissues. Mr. Guthrie proposes, in the event of the protrusion being only omentum, that it should be retained between the cut edges of the peritoneum, but without the slightest pressure or possible strangulation, in order that by its retention it may more readily adhere to these edges, and thus form a more certain barrier against the extension of inflammation than is likely to take place when moving at liberty in the cavity of the abdomen, however closely it may be supposed to be applied to the inner surface of its paries. Mr. Erichsen suggests that the abdominal muscles should be relaxed by bending the thigh upon the abdomen, when the protrusion may be pushed back by steady pressure upon it, but no force should be employed. If the parts cannot be reduced, the aperture through which they have escaped must be enlarged in the direction upwards. In replacing them, care should be taken that they are fairly put back into the cavity of the abdomen, and not pushed into the sheath of the rectus or in front of the peritoneum. The surgeon should not push the finger into the abdomen, but simply replace the protruded gut or omentum, and allow it to remain in the neighbourhood of the wound, to which it will contract adhesions.

Mr. Pollock recommends that if the omentum be bruised, lacerated, or dirty from contact with the ground or other materials, inflamed or congested, or

if the mass be not considerable, but there be much resistance to its reduction, without enlarging the wound, a ligature should be passed round the base of the omentum, or a double thread be passed through it, and each thread tied round it, and the mass anterior to the ligature cut off and stump pushed back into the abdomen, the ligature being allowed to remain out. If the protruded mass of omentum be very large and not injured, but the wound not sufficient to allow of a ready return, the wound should be enlarged, and part replaced; but if it be lacerated, bruised, or congested, it may be removed with safety. Its removal will be less serious than if left to suppurate in the wound, which should then be closed by means of sutures, care being taken that all hæmorrhage has ceased. The sutures should include the skin and the peritoneum, so as to secure perfect apposition of the edges of the wound, and prevent the escape of intestine into the gap of the deeper part of the wound, which would be formed if the peritoneum were not included.

In returning protruded masses of omentum or intestine, great care and gentleness are required; if both are protruded, the latter should be pushed back first, and if strangulated, the cause of constriction must be removed.

Gangrene of Protruded Intestine.—Should the protruded part of an intestine become gangrenous from continued contraction and exposure, it should not be reduced, but an incision should be made through it, or the gangrenous part removed, so as to clear away feces and admit of an artificial anus, by attaching the cut edges of the bowel to the wound in the abdomen. This operation is not dangerous if deferred until adhesions at the orifice have formed a barrier to the extension of inflammation.

Wound of Protruded Intestine.—Protruded intestine may be punctured, incised, lacerated, or completely divided. These are very formidable injuries to deal with, as it is clear that the escape of feculent fluid, though of the smallest quantity, may give rise to violent peritonitis. Some difference of opinion among surgeons has existed as to the proper method of dealing with the wounded gut. Searpa and S. Cooper were opposed to the practice of stitching it, on the ground that it does not prevent extravasation, and that the stitches produced irritation by acting as foreign bodies. On the other hand, Guthrie, Travers, Longmore, Bryant, Pollock, and other experienced surgeons advocate the practice.

Guthrie recommends that when an incised wound in the intestine is not supposed to exceed a third of an inch in length, no interference should take place; for the nature and extent of the injury cannot always be ascertained without the committal of a greater mischief than the injury itself. When the wound in the external parts has been made by an instrument not larger than one third (or from that to half) of an inch in width, no attempt to probe or to meddle with the wound, for the purpose of examining the intestine, should be permitted. When the external wound has been made by a somewhat

broader and longer instrument, it does not necessarily follow that the intestine should be wounded to an equal extent; and unless it protrude, or the contents of the bowel be discharged through the wound, the surgeon will not be warranted in enlarging the wound in the first instance, to see what mischief has been done. "When the wounded bowel protrudes, or the external opening is sufficiently large to enable the surgeon to see or feel the injury by the introduction of his finger, there should be no difficulty as to the mode of proceeding. A puncture or cut, which is filled up by the mucous coat so as to be apparently impervious to air, does not demand a ligature. An opening which does not appear to be so well filled up as to prevent air and fluids from passing through it, cannot usually be less than two lines in length, and should be treated by sutures. When the intestine is more largely injured, in a longitudinal or transverse direction, or is completely divided as far as, or beyond, the mesentery, the continuous suture is absolutely necessary."

Mr. Longmore recommends that when a protruding intestine is found to have been opened by a projectile, or to be gangrenous, the part so wounded should not be returned, but steps should be taken to try and form an artificial anus so as to imitate the usual means of a natural cure when recovery follows a gun-shot wound with penetration of intestine.

Mr. Travers advocates the stitching up of a wounded intestine, and bases his opinion on the result of experiments which proved that when a wounded gut was sewn up and returned into the abdomen, the lymph was effused on the external surface of the bowel consequent on such an operation, and the stitches rapidly cut their way into the interior of the bowel, and were passed away into the stools.

Mr. Pollock, in speaking of these wounds, observes: "A wound of protruded intestine or stomach, if small, should be secured by ligature; if large, by sutures; and protruded viscus returned into the abdomen. The former lesion may terminate in recovery, but wounds amounting to direct division of the canal are irreparable, unless artificial anus be established."

From the great experience obtained during the American War of the Rebellion, it was found that in all punctured and incised wounds of the intestinal canal attended with protrusion, the safest practice consisted in closing the intestinal wound by suture, and reducing the protruded viscus, unless its structure was irretrievably disorganized, and the adoption of the alternative of establishing a preternatural anus was compulsory.

Wounds of the intestines without protrusion are of most serious nature, their effects depending greatly upon the condition of the viscus when wounded. Should the stomach, intestine, or bladder be distended, extravasation into the abdominal cavity will almost to a certainty take place, which will be followed by shock and diffuse peritonitis; but if these organs are not distended, the injury may be very limited, giving rise to local inflam-

mation, and in all probability sealing of the wound. Mr. Otis considers that in wounds of the small intestines, when there is any danger of extravasation, the external wound should be enlarged and the wound in the intestine closed by suture. Wounds of the large intestine, he considers, often do well without interference, and in these wounds enteroraphy will seldom be requisite, unless the wounded colon protrude; yet he says there are exceptional cases, in which extending the external wound and sewing up the rent in the gut is the best and only means of preventing extravasation.

Method of stitching Wounded Intestines.—Numerous stitches have been advocated by different authorities.

Ballungal recommends M. Lembert's plan of operation for wounds of intestine: "A small stitch, including only the peritoneal coat of the intestine, is to be taken up on one side of the wound, at the distance of a line or

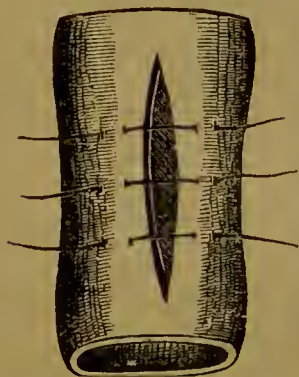


Fig. 89.—Interrupted sutures of Lembert.

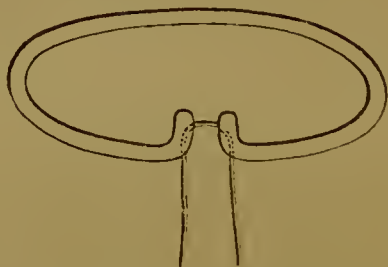


Fig. 90.—Shews the inversion and approximation of the serous surfaces.

two from its edge; the needle is then carried across the wound, and a similar stitch taken up on the opposite side at the same distance from its edge; in this way a number of ligatures are introduced at the distance of a quarter or half an inch from each other (fig. 89); and when these come to be tied, the wound is completely closed, the serous surfaces of the peritoneal coat on either side of the incisions are brought into contact, and the lips of the wound are left projecting into the intestinal tube" (fig. 90).

Mr. Erichsen recommends that in making stitches "they should be introduced by means of a fine round needle armed with sewing silk, in such a way that the peritoneal surfaces on each side of the wound are brought into contact. Adhesion takes place slowly between these, the wound in the other structure of the gut filling up by plastic

deposits" (fig. 91). He considers it difficult to follow out the plan proposed, of the needle only penetrating the peritoneal and areolar coats, no muscular tissue being taken up, and is of opinion that the safer plan is doubtless to carry the suture through the whole thickness of the gut, bringing the stitches out at about one-sixth of an inch from the edge of the cut in such a way that the serous surfaces are drawn into apposition. The ends of the stitches should be cut short close to the knot.

Mr. Pollock does not appear to lay any particular stress on the nature of the sutures in wounded intestines, remarking that some little fancy may be exercised in the choice of sutures ; but that it is a minor consideration.

M. Legouest recommends an ingenious plan (originated by Dr. Vézine) of closing a wound in the intestine, the knots of the suture of which are placed in the interior of the gut.

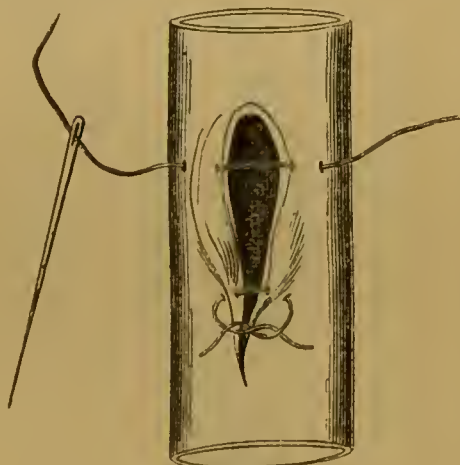


Fig. 91.

A fine thread, armed at both extremities with a common sewing-needle, is sufficient for the operation. The needles should penetrate 2 or 3 millimetres (1 millimetre = $\cdot 03937$ of an inch) on each side of the exterior and interior edge of the wound (fig. 92), and be brought out through the wound with the threads, which are passed twice round one another to form the surgical knot (fig. 93). This knot is not tightened till later, but the needles are reintroduced successively into the wound and back through the intestine at a point about 10 millimetres further from the first knot, bringing back the thread with them (fig. 94). As many points of sutures are thus made as may be required.

In order to bring the edges of the serous membrane into apposition, it is

necessary to draw tightly on the ends of the thread, tie them, and cut them short at the point of exit.

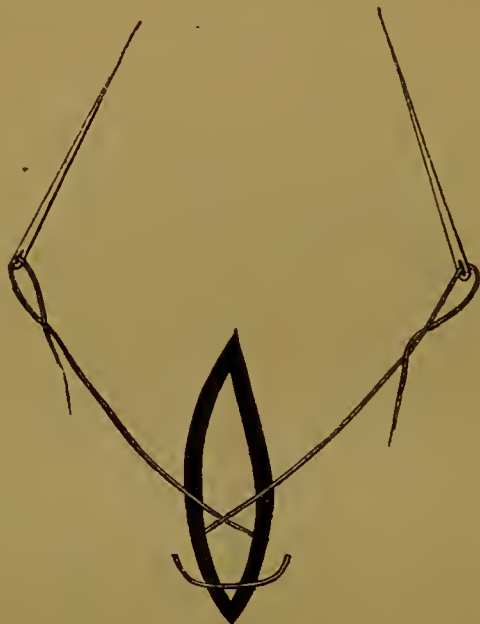


Fig. 92.



Fig. 93.

Travers recommends that "a small sewing-needle armed with a silk thread be passed near the lines formed at the base of the everted lips. This thread is

to be carried at short regular distances through the whole extent of the wound, the operator being mindful that an equal portion of the edges is included in each stitch ; when the suture is finished let the thread be securely fastened and cut close to the knot. The reduction of the collapsed fold should then be conducted with the utmost caution, and, when completed, the wound of the tegument should be treated with a stitch, a plaster, or a poultice, as circumstances may dictate. Again, he says, whenever the suture is decided upon it should be complete, the intestine should be returned fairly into the abdomen, and wound of parietes treated as if it had not extended beyond them.

Having given the opinion of some of the most eminent authorities on the subject of a wounded and protruded intestine, a summary may now be made



Fig. 94.

as to what the surgeon should do. The parts should be thoroughly cleaned with a little tepid water, and if there is an incised wound, its edges should be brought together by means of sutures, that proposed by Travers being probably the most suitable. The intestine is then to be returned with great care to the abdomen, provided there be no contraction ; but should such exist, the outer wound is to be enlarged.

The wound of abdomen must be treated as if the wound of intestine did not exist.

In the event of the wound of intestine being gangrenous or extensively lacerated, so that the edges cannot be brought together, or that they are injured, as by a gun-shot wound, the course to be adopted is to stitch the upper portion of the intestine to the abdominal wound, with a view to the

formation of an artificial anus. The position of the patient in all wounds of the abdomen is of the greatest importance; it should be so that the muscles are relaxed. The diet should be of the mildest description; no stimulant of any kind whatever should be given. The topical treatment should be bland and soothing, and the surgeon must ever be on the watch for the approach of peritonitis, which is the great danger to be apprehended in all injuries of the abdomen; wounds of these parts are always followed by peritonitis, as part of the process of healing; but then it is local and confined to the immediate neighbourhood of the injury. But the diffuse peritonitis is more serious; accompanied by tenderness all over the abdomen, especially at the wound, tympanitis, vomiting, hiccough, hard, quick, and small pulse, great heat of skin, and anxious countenance. This traumatic peritonitis is attended with exudation of serum or ill-conditioned lymph, and will run its course in a very short time.

Treatment of Peritonitis.—In the treatment of peritonitis, the surgeon must be guided by the condition of the patient. If he is young, strong, and healthy, it will be necessary to remove blood from the arm, or to apply numerous leeches over the abdomen, followed by warmth in the form of poultices or fomentation.

In the American War of the Rebellion, as far as can be learned, in the armies on either side, venesection was abandoned in the treatment of peritonitis, even more completely than in wounds of the chest. Opium should be freely given, and its influence closely watched. It may be administered hypodermically, when rejected by the stomach, or by means of suppositories. Calomel with the opium may be administered either at short or more lengthened periods. The influence of the opium on the sufferer is a guide to continuing it or not. Or opium and mercurial inunction may be adopted; the latter being highly spoken of, especially when used as commended by the elder Larrey, vesication of the entire surface having been first established. The diet should be just enough to support nature, in the form of barley water, whey, light drink, ice, or cold water at first, and then the blandest of nutriment, such as milk, sparingly allowed. Circular bandages have been recommended. The patient should not be moved or move himself, and, as a distinguished authority observes, men with penetrating wounds of the abdomen should be permanently treated as near as practicable to the spot where they fall. Every rod, he continues, they are transported adds to the formidable peril they have already encountered.

Extravasation of blood into the abdominal cavity may arise from injuries of the aorta and its branches, lesions of the vena cava and portal vein and their ramification, or from wounds of the viscera. In the treatment of intra-abdominal hæmorrhage the surgeon may adopt absolute immobility, occlusion of the external wound, application of refrigerants; internally, cold, acidulated, or saline drinks, opiates or digitalis, veratrum viride or

gallic acid. Phlebotomy has been recommended by eminent French and German surgeons, but is not generally advocated.

When internal bleeding proceeds from vessels of the abdominal walls, they should be secured by ligature, and searching for them by introducing the finger into the wound in the abdomen, the bleeding vessel may be recognised by the warm jet of blood.

Guthrie considers that if a punctured or incised wound be small, and the extravasation or effusion within the cavity seem to be great, the wound should be carefully enlarged and the offending matter evacuated.

When effused blood forms a circumscribed tumour, giving rise to inflammatory products, it will be necessary to evacuate it.

Foreign bodies lodged in the cavity of the abdomen are not of uncommon occurrence, and instances have been adduced where they have become encysted and ultimately eliminated by stool. The act of exploring shot wounds of the belly for lost missiles is decidedly objectionable; at the same time; there are authorities who consider that, when practicable, they should be removed.

Colotomy.—Mr. Christopher Heath recommends the following operation (*British Medical Journal*, December 1, 1877): Place the patient on the right side, with a pillow under the loin, in order that the left loin may be thrown into greater prominence. Then measure a point midway between the anterior and posterior superior spines of the ilium, and from that point draw a vertical line upwards to the last rib. This line will give you the position of the bowel. Then make an incision 4 inches long, somewhat obliquely, between the crest of the ilium and the last rib, half of the incision being on each side of the vertical line marked out. It should be slightly oblique, running parallel to the last rib. In making this incision, you divide the skin, subcutaneous fat, the external oblique and latissimus dorsi muscles, thus exposing the internal oblique; you now expose the fascia lumborum, which you carefully divide on a director. You have now exposed the loose fat about the kidney and colon in the anterior part of the wound, and the edge of the quadratus behind. The bowel may be found just in front of the quadratus lumborum, and should be brought into the wound with the hooked finger; its posterior surface should be exposed. With a large curved needle you pass a stout silk thread through the skin to one side of the ink mark across the bowel, and again through the skin at a corresponding point on the other side of the mark, repeating the proceeding at the other end of the incision. Thus the colon is held to the margin of the wound before being opened. A transverse incision is now made into the bowel between the threads, and, the finger being introduced, the two loops can be drawn out, and, on dividing them, you have four threads to fix the bowel to the wound only requiring to be tied. The rest of the incision on each side of the bowel is then closed by ordinary sutures, and the operation is completed.

WOUNDS AND OTHER INJURIES OF THE SPINE.

INJURIES of the spinal cord may be divided into concussion and compression, the same as injuries of the brain, to which they bear much resemblance.

Concussion may occur directly or indirectly, as, for instance, from a blow, or by falling from a height on the buttock.

Mr. Alexander Shaw says, in his remarks on Concussion of the Spinal Cord: "But certain cases of injury of the back are met with in which paraplegia has directly or shortly afterwards occurred, and in which, upon examination of the spine after death, no fracture, displacement, extravasated blood, or anything capable of compressing the cord, can be discovered. The explanation therefore given is, that the spinal cord had been damaged by concussion."

The following symptoms of concussion are usually present from direct violence: pain at the seat of the injury, vomiting. If the phrenic nerve is irritated, hiccough, and feeling of constriction round the body will be present. When the vagus nerve is irritated, there will be a sense of suffocation, with probably irregular action of the heart and distressing vomiting. There may be loss of power over the sphincters of both bladder and anus, with incontinence or retention of urine or fæces, or the bladder only may be affected.

In concussion from indirect violence, the symptoms are sometimes insidious and protracted. The injuries may have been received elsewhere, but subsequently disease is developed in the spinal cord.

Concussion of the spinal cord is more frequently met with in civil life than in the army, but may occur with the soldier from a spent ball or fragment of shell, from the falling of planks or earth in the explosion of mines or magazines, or in assaults from men falling back into ditches, as observed by the writer.

Treatment.—In treating these injuries, absolute rest to the parts is the principal object to be arrived at.

Mr. Erichsen, who appears to have made a special study of this subject, says: "The importance of rest cannot be over estimated. Without it no other treatment is of the slightest avail." He considers it of the utmost importance to insist upon absolute and entire rest for this reason, that not infrequently patients feel for a time benefited by movement, but nothing can be more erroneous than this idea, for the patient will invariably be found to fall back into a worse state than had previously existed. With this rest, which should be in the prone position, he recommends chloral to procure sleep, and the bromide of potassium to allay the irritability.

Counter irritation may be applied to either side of the spine, and if there are inflammatory symptoms present, ice may be used with advantage: subsequently tonics in the form of iron, strychnine, and cod liver oil.

Compression of the spinal cord may be induced by injuries to the vertebræ, such as fractures, dislocation, penetration by gun-shot wounds, or by extravasation of blood or pus. The symptoms produced depend much upon the position of the injury.

These injuries are of the greatest interest to the surgeon, as much will depend, as regards the future of the sufferers, on the amount of damage inflicted.

Wounds of the spine in army practice are not much complicated, and it is seldom that the surgeon has an opportunity of being left in any doubt as to the exact seat of injury, the wound and its results being so self-evident.

In dislocations or fractures without an external wound, the symptoms which generally present themselves are shock to the nervous system, profound collapse, pain in the seat of injury, tumefaction of injured part, unevenness or depression of projections in the process of the vertebræ, paralysis of body below the level of fracture.

Paralysis in Injury of Spine.—The extent of paralysis differs according to the part of the spinal column injured, as, for instance, fracture or dislocation in the cervico-dorsal region, all the body below seat of fracture will be paralysed, and if the injury to the cord has been above the origin of the first dorsal nerve, which joins the axillary plexus, some impairment in the motion and sensation of the upper extremities will be discovered; but the principal danger overhanging the patient is connected with his respiration.

Fracture and dislocation in the dorsal region, between the tenth and fourth vertebræ, causes complete paraplegia. The bladder and rectum will be paralysed, and bed sores are sure to be formed.

In fractures or dislocation of the lower lumbar, there may be no paralysis, if the injury is below the second lumbar vertebra, in consequence of its being below the level of the spinal cord, which terminates at the second lumbar.

Injuries of the spinal column, above the origin of the phrenic nerve, are attended with instant death.

Treatment.—No attempt should be made to reduce a fracture or dislocation of the spine. Means should simply be adopted to support nature by means of nourishing diet, to prevent sloughing bed sores, by placing the sufferer on a water bed or soft mattress.

Urine should be drawn off regularly, and great cleanliness observed.

The bowels may be moved involuntarily at first, afterwards they may be constipated, when they should be relieved by enemata.

In penetrating wounds, where the vertebræ may be driven in on the cord, splinters, articles of clothing, and muscular tissue, may have to be elevated, extracted, or removed. With a view to enable the surgeon to do this, the trephine, elevator, or small saw, may be had recourse to.

The Trephine in Injuries of the Spine.—Mr. Longmore, in speaking of the

use of the trephine in these injuries, says: "In injuries of the vertebral column and spinal cord occurring in military practice, the mischief is usually so complicated and extensive, and the medulla itself so bruised, that the cases must be very rare indeed in which the operation of trephining, if justifiable in any case, can offer the slightest prospect of benefit." He mentions that M. Baudens extracted by means of an elevator a ball which had lodged in the eleventh dorsal vertebræ, and was causing compression with complete paraplegia. The paralysis disappeared immediately after the extraction of the bullet; but tetanus came on four days afterwards, and proved speedily fatal.

Sir C. Bell condemned trephining the spine, but the measure has its advocates.

The operation is one attended by considerable trouble and difficulty, and when completed it may be discovered that the cause of compression is out of reach, being displacement of a body of a vertebræ instead of a depression of an arch or process.

The course recommended to be adopted in applying the trephine, is first to make an incision in the line of the spinous process about an inch deep and 6 inches in length, or according to the extent of the injury, through the skin and muscles, which should be cleared away on either side of the spine, and bony structure exposed to admit of the trephine being applied. Before using the instrument, loose pieces of bone should be elevated and removed, care being taken not to push any spiculæ into the spinal cord.

Hey's saw and a cutting pliers will be found most useful in dividing processes or arches.

Mr. Shaw considers that, "in injuries of the spine, except in those cases of fracture high in the spine, in which respiration has been interrupted, the paralysis is not the direct cause of the fatal termination.

In cases of fracture generally, "the chief dangers to life arise from extensive and exhausting sloughs and bed sores, morbid conditions of the bladder and urinary organs generally, and in a certain degree derangement of the bowels. These are indirect effects of the paralysis. But if they be overcome, the mere loss of motion and sensation in the limbs, and inability to control the action of the bladder and rectum, will destroy life, or be inconsistent with the patient enjoying good health. The principal aim in treatment ought to be to avert those bad consequences, and endeavour to preserve life without incurring formidable risks in expectation of getting rid of the paraplegia."

INJURIES TO AND WOUNDS OF THE PELVIS.

Classification of Injuries to and of Wounds of the Pelvis.—Mr. John Birkett arranges injuries of the pelvis in the following manner:—

I. Contusion involving the soft parts in contact with the outside of the pelvis

II. Fractures and dislocations of the bones forming the pelvis.

III. Injuries of those organs in relation with the pelvis which are connected with the functions of—

A. Micturition; B. of Generation; C. of Defæcation.

As compared with penetrating wounds of the abdomen, wounds of the pelvis are far less fatal, due probably to the fact that in wounds of the belly the limits within which the reparative efforts of nature can be assisted by art are very limited.

Contusions of the Pelvis—Contusions of a slight form require no difference in their treatment from similar injuries in other parts of the body. At the same time, Mr. Birkett remarks: “Contusions of an apparently trifling nature, at first slight, may yet be attended with appalling results. Thus, a delicate, strumous, badly-nourished individual receives an injury of the pelvic region, the primary effects being merely a local tenderness or stiffness. But in a few days intense constitutional disturbance may arise, and death ensue from disease of the membranes of the spinal cord.”

Contusions may be of a severe nature, as from a spent cannon-shot or fragment of shell, producing great extravasation of blood under the integuments or gluteal fascia, giving rise to a circumscribed swelling, which may be recognised from that of an abscess by its appearing immediately after receipt of injury, whereas an abscess would be longer delayed. These swellings will, as a rule, disappear after repose and local application of stimulating lotions.

The soft parts covering the pelvis are frequently torn and lacerated by fragments of shell, splinters of wood, and other missiles. The wound should be readjusted, as far as possible, with a hope of their uniting.

Fractures, Dislocations, and Gun-shot Injuries.—The pelvic bones may be fractured, dislocated, and crushed; or bullets, fragments of shells, &c., may be lodged in them. Such injuries are attended with risk to life, not alone from the damage to the bones, but from the contents of the region being involved in the mischief. In the treatment of fractures, most perfect rest should be enforced, the bones being first replaced, if possible. Dislocations should be reduced, and to assist the surgeon in doing so, “it is recommended to introduce the index finger into the rectum, while the patient is under the

influence of chloroform, when the bones may possibly be brought into their normal relations with the sacrum."

In shot fractures there may be contusion, grooving of a single lamina, cleanly cut perforations, sinuous canals through the cancellated structure, comminutions with widely radiating fissures, detachment of fragments, or impaction in the spongy tissue. Much of the gravity in shot perforations of the pelvis will depend (as in chest perforations) as to whether the missile fractures the bone on entering, driving the splinters inwardly, traversing the bony basin, or fractures it when emerging.

When the pelvis has been struck by a large shot, unless very obliquely, the destruction is so frightful that death ensues before inflammation has time to set in. Dr. Stromeyer has pointed out two important facts in relation to these injuries, which were corroborated during the American War of the Rebellion, viz., the liability to pyæmia and to greater danger where the missiles entered posteriorly and traversed the thick gluteal muscles, before fracturing the bone, the long shot tracks favouring purulent infiltration and sloughing.

Lodgment of Missiles in the Pelvis.—Mr. Guthrie has removed balls on different occasions which have lodged in the pelvis, and always with the greatest advantage when done early. He has seen much evil result from their being allowed to remain, as they caused not only frequent distress, but at last gave rise to disease in the bone, derangement of the general health, and death. "When the ball can be felt impacted in the bone, incisions through muscular parts of little consequence should not be spared to expose it. If an error exists at this moment, it is that too little is done rather than too much."

Mr. Hamilton, of the U.S.A., remarks: "If a ball has penetrated either of the alæ, where they are thickly covered by the great gluteal muscles, it would be difficult to discover or to remove the fragments. The great depth of the muscular coverings, and the size and number of the blood-vessels with which they are supplied, render all surgical interference improper. But in case the perforation occurs near the upper margin of the pelvic bones, there can be no impropriety in instituting a search for any foreign substance which may be supposed to have lodged within. If the edge of the crest only is broken off, the finger can be easily carried along the track of the wound to a certain extent, and the probe may be introduced pretty freely without much danger of its doing harm. Indeed, it is our opinion that, in case the perforation was very near the crest of the ilium, constituting only a smooth, round hole, through which the loose fragments could be distinctly felt, but was insufficient for their extraction, it would be proper to apply the trephine, so as to enlarge the opening. Certainly there is no more important indication than to remove the fragments, and we do not see why the surgeon, under these circumstances, need hesitate to perform so trivial and safe an

operation at once. For this purpose a large trephine should be employed, and in order to avoid the necessity of dissecting up the muscles extensively for the purpose of finding a sound piece of bone upon which to rest the pin of his trephine, he might adopt the excellent suggestion of Mr. Guthrie in certain cases of fracture of the skull—namely, to support the crown of the instrument in a circular opening made in a bar of iron, the two ends of the bar being held and steadied by assistants; or perhaps it would answer equally well to employ for this purpose a piece of wood, the opening in which may have been previously made by the trephine itself.”

Baudens recommends that when a missile perforates the ilium and lodges under or in the iliacus or psoas muscle, it is safer to seek it through an incision similar to that made for ligation of the common iliac artery, rather than to enlarge the shot canal in the bone.

Necrosis and caries frequently follow shot injuries of the pelvis, the patients leading miserable lives from the recurrence of suppuration and its consequences.

WOUNDS OF ORGANS OF MICTURITION.

Wounds of the bladder may be caused by concussion, without fracture of the pelvis, by the wheel of a gun-carriage passing over, by a fall, or by a heavy weight giving rise to rupture; with fracture of the pelvis, by splinters of bone, by bullets, or other missiles, bayonet, lance, or sword thrusts, a large vessel may be wounded, which may prove rapidly fatal from hæmorrhage.

All wounds of the bladder are extremely dangerous, but those produced by shot are less so than others, due, it is suggested, to the tissues being crushed by the projectiles, that eschars are produced, and the connective tissue protected from urinary infiltration.

Should the bladder be wounded, the sufferer may be so fortunate as not to be hit in a place where immediate extravasation of urine takes place, and consequently he may survive the wound, but will be subject to great suffering from inflammatory symptoms consequent on the injury producing irritability of the bladder and tenesmus. “The first measures, therefore, to be adopted are to introduce a large elastic catheter and fix it in the bladder, so as to admit of the urine passing through it, as soon as formed, and prevent irritation by lodgment. Some patients will not tolerate its being fixed in the bladder; it must then be introduced frequently.”

In the event of the bladder being injured so as to admit of extravasation into the pelvic cavity, or peritoneal cavity, the case will probably terminate fatally, from the amount of irritation and inflammatory action, or the shock on the system.

I have already mentioned that in these injuries an attempt should be made to prevent further extravasation by the introduction of an elastic catheter; as, however it is generally a considerable time before wounded come under the care of the surgeon, the mischief from extravasation will have taken place; but this is not to prevent an attempt being made. In cases where the back part of the urethra or neck of the bladder has been injured, so as to prevent the introduction of a catheter, an opening should be made in the perineum to admit of the discharge of urine.

Should there be signs of external extravasation, free incisions must be made in the perineum, or such positions as will readily admit of its escape, and that of decomposed cellular tissue.

The early constitutional treatment in all wounds of the bladder should be that commonly adopted in acute peritonitis, which must inevitably set in. Local or constitutional bleeding may be necessary. The bowels will require evacuation by means of oil enemata, but opium must form the great means of affording relief, and it may be administered by the mouth, by hypodermic injection, in the form of a suppository, or by enema. The bladder should be kept in a state of complete contraction and repose, which is one of the most essential steps towards the healing of the wounds in its walls. Drinks should therefore be in small quantities. The diet should be very sparing at first.

Protrusion of the Bladder.—The bladder may be protruded in consequence of a wound in the abdomen, when it should be returned. This operation is facilitated by a gum elastic catheter being introduced and the urine drawn off.

Bullets or other Foreign Bodies in the Bladder.—Shot wounds of the bladder are not uncommonly complicated by the presence of foreign bodies in the cavity of the organ, such as bullets, pieces of bone, clothing, hair. These may become encrusted with urinary deposits, and after a time require removal by the operation of lithotomy. In the Reports of the American War of the Rebellion, twenty-one cases, with three deaths, are given of lithotomy for extraction of projectiles or traumatic vesical calculi.

Puncture of the Bladder.—The surgeon is sometimes called upon to perform this operation for retention of urine consequent on injuries of the urethra. Mr. Cock's method, per rectum, is the most simple, and is as follows: "The patient is to be placed and held in the position for lithotomy, and brought well to the edge of the bed. The operator is then to introduce the index finger of the left hand into the rectum with the palm upwards, and to feel for the prostate, and, if possible, for the bulging base of the tense bladder beyond it, some little pressure above the pubes may help in this attempt. The pulpy point of the index finger is then to be held in the median line, just below the spot at which the puncture is to be made. The surgeon, with his right hand, is then to take from his assistant the canula,

well oiled, and fitted with the blunt pilot trochar, and introduce it into the rectum, upon his left index finger, passing it well up to the point selected for puncture. He is then to steady the canula and hold it firmly in position with the thumb and three outer fingers of the left hand, and withdraw the blunt trochar. The sharp trochar is then to be introduced through the canula, and having reached its end, the handle with the canula is to be depressed and then driven home in a direction upwards and forwards, in a line towards the umbilicus. The trochar should then be withdrawn, and the canula pressed well home and secured. A plug may be placed in the canula to retain the urine."

The operation of lithotomy may be required in war time for the removal of bullets or other missiles from the bladder. The operation (lateral) is thus described by Sir W. Fergusson: "The point of the blade of scalpel should be entered about $1\frac{3}{4}$ inch in front of the anus, about a line's breadth left of the raphe, pushed through the skin, and carried by a kind of sawing motion down the left side of the perineum, about $1\frac{1}{4}$ inch beyond the anus, the middle of the incision being at equal distances from the latter part and tuberosity. Next, the blade should run along the surface of the exposed fat and cellular tissue, and then the point of the forefinger of the left hand should be thrust into the wound a little in front of the anus, so as to penetrate between the accelerator urinæ and the erector penis muscles—the knife being applied to any part which offers resistance; when, with a little force to separate the tissues, the tip of the finger can be placed upon the membranous portion of the urethra, and the groove in the staff may be distinctly felt. The point of the blade, with the flat surfaces nearly horizontal, should now be carried along above the finger, made to perforate the urethra about three lines in front of the prostate, and then be slid along the groove until it has entered the bladder, having slit open the side of the urethra, and notched the margin of the prostate in its course. The forefinger of the left hand should next be slipped slowly into the bladder along the staff, in such a manner as to cause dilatation of the surrounding textures, and its point should be moved about in search of the stone, which, being found, should be retained in position near the neck of the viscus; then the staff should be removed, and the forceps introduced along the upper surface of the finger, slowly withdrawing the latter as the former makes progress: this will be denoted by a gush of urine, at which instant the blades should be separated, when on gently approximating them, the stone will in all probability be felt enclosed."

WOUNDS OF THE ORGANS OF GENERATION.

Wounds of the Penis, Perineum, and Urethra.—Missiles have been known to traverse the penis and perineum, and otherwise injure these parts. In

wounds where the urethra has been laid bare, a catheter should be introduced and tied in; and, if the wound be clean, with edges in such condition that adhesion might be anticipated, they should be brought together by interrupted sutures; but, if much lacerated, it will be necessary to wait patiently the process of healing by granulation, taking care that the urethra is kept free by the introduction of a catheter whenever the patient requires to pass water. When the laceration has been so extensive that closing by granulation is impossible, it is best to try and retain the direction and patency of the urethra as far as practicable by frequently introducing a sound or catheter, and afterwards close the wound with a plastic operation.

Erections are a great hindrance to the healing of wounds of the penis, they tend to induce hæmorrhage and necessarily break up incipient adhesions, retarding union. The parts should be lightly dressed, the bed should be hard, regimen spare, and excitement avoided. Camphor and hyoscyamus may be given with advantage.

Retention of urine is not uncommon with laceration of the urethra; an attempt should first be made to pass a catheter, which should be done with the greatest gentleness. If this is impossible from the torn condition of the urethra, the bladder should be punctured. On the first appearance of infiltration deep and free incisions are necessary.

Foreign Bodies in the Urethra.—The urethra may be obstructed by foreign bodies being driven into the canal by projectiles, or expelled from the bladder, such as fragments of bone, clothing, and small projectiles. When situated near the meatus it is possible to remove them with a small forceps, a bent probe, or metallic loop; but should such simple means be unavailing, it will be necessary to resort to incision, which would be more prudent than incurring any danger to the canal by persistent efforts at extraction.

Wounds of the scrotum, when uncomplicated, are not very serious, and require but little interference; open wounds should be closed by sutures, and the parts dressed with cold water and well supported. It may be laid down as a general rule that all incised or lacerated wounds of the genitals should be closed by sutures, if the parts can be possibly brought together.

Balls may lodge in the scrotum without doing any injury to the testes or other parts, and should be removed.

Wounds of the testes cause intense pain, extending to the lumbar regions, attended by faintness, and often by vomiting and even collapse. They may be severely bruised, shattered, or detached from the cord. Of 586 cases of this group reported as having occurred during the American War, the largest proportion consisted of lacerated wounds of one or both testes.

Relief must be afforded by the administration of opium; the organ should be well supported, and cold or warm water applied. Should there be any portion of either testicle partially detached, or extensively lacerated, it may

be removed, as in all probability it will become diseased. Guthrie removed the bruised and shattered remains of testes and epididymis to expedite the cure.

Wounds of the spermatic cord are generally associated with wounds of the testes; they are of infrequent occurrence, and rarely lead to fatal consequences; it may, however, be necessary to ligature the spermatic artery in cases of violent hæmorrhage from it.

WOUNDS OF THE ORGANS OF DEFÆCATION.

Wounds of the Rectum and Anus.—Lacerated and incised wounds of these regions are rare in war, the parts being more or less protected, but shot wounds of the rectum are not infrequent.

During the Crimean War and Indian Mutiny, the writer only saw one example of this description of wound, which occurred to a soldier who, while attending to the calls of nature in an advanced trench, and in the squatting position, was struck with a fragment of a shell, which removed the scrotum as if it had been done by a knife, lacerated the buttocks, and divided the sphincter ani, causing violent hæmorrhage and involuntary passing of stools. The misery and intense suffering of this patient can scarcely be described, and as the healing process was entirely by granulation, he was a long time under treatment.

Incised wounds of the rectum and anus heal very readily, but from their close proximity to the bladder and peritoneum, inflammatory symptoms must be looked for and checked. The bowels should be kept in a state of perfect repose, and strict cleanliness of the parts observed.

Shot wounds of the rectum are generally complicated with fractures of the pelvic bones or injury of the bladder, and most commonly prove fatal from pelvic cellulitis, blood poisoning from fecal infiltration, diffuse supuration, or secondary hæmorrhage. Should a patient with such a wound survive, he will in all probability suffer from a stercoral or urinary fistula, kept open by discharges from carious bone or the occasional escape of sequestra. These injuries may also give rise to paralysis with incontinence of feces, obstinate constipation, stricture, muscular contraction, and recurrent abscesses.

Dupuytren recommended a division of the sphincter in cases where the feces were retained and overflowed through the perforation in the upper part of the gut. This practice was adopted with most satisfactory results during the American War and the Franco-German War of 1870-71.

Hæmorrhage of the rectum should be promptly attended to; a bladder may be introduced and dilated with ice water directed from a tube attached

to an inverted bottle or irrigator. In serious hæmorrhage the gut must be dilated by a speculum (fenestrated), and bleeding vessels secured if possible. It may however be necessary to apply the actual cautery, galvanic current, or perchloride of iron.

WOUNDS OF THE EXTREMITIES.

Classification of Wounds of the Extremities.—These wounds may be divided into contusions, lacerations, incisions, or punctures of soft parts, injuries of bones or joints, all of which may be complicated with wounds of the great arteries or nerves.

With regard to contusions, lacerations, incisions, or punctures, their treatment has already been remarked upon ; it is therefore unnecessary to refer to these again. Injuries of bones and joints will now be considered, and, in connection with them, wounds of arteries and nerves.

General Remarks on Gun-shot Fractures.—"Bones may be injured by having the periosteum contused or removed, as when a bullet is flattened against them, giving rise to periostitis, exfoliation, or throwing off of scales, and frequently to disease of the medulla, or formation of deep abscesses, producing great constitutional disturbance."

Bones may be fractured, which injuries, as in civil life, are divided into simple, compound, and comminuted ; but in consequence of the instruments or weapons which inflict them in war, they, as a rule, present peculiarities to the army surgeon not met with in civil life, where accidents to bones generally arise from falls, kicks, or muscular action, whereas in the army fractures are for the most part caused by direct violence, by spent cannon-shot, bullets, slugs, grape-shot, fragments of shell, and other missiles, causing many complications.

Simple fractures are probably the most rare of all met with on active service ; but should such occur on the field, the surgeon will have much to consider, as from any want of care, or from improper adjustment of splints, the broken ends of the bones may protrude through the soft parts, forming a compound fracture, or by the rubbing together of the ends of the bones extensive inflammation may be set up, followed by suppuration and prolonged disease, or should the appliance be too tight, gangrene of the limb may follow.

There may be great contusion of the soft parts, which will interfere with the adjustment of the splints, and add to the difficulties in transport. Numerous plans have been invented and proposed for the transport of fractured limbs, such as plaster of Paris bandages, wire-trough splints of the French, and various splints made from materials which may be found

at the time of the injury, as already described under the head of "Extemporary Appliances" (page 27 *et seq.*).

Compound fractures are usually produced by the direct contact of a bullet or other missile with the bone, and consequently inflicting most serious injury to the bone itself and surrounding parts, but not necessarily producing a comminuted fracture, as might be expected.

Partial Fractures.—Professor Longmore describes partial fractures, which he says "can scarcely be produced by any other agents besides projectiles, and which are rare accidents in civil practice. They are : 1. Removal of portion of a bone by the projectile making a furrow in its passage across its surface—grooving it ; 2. Removal, splintering off, of longitudinal fragments from the external cylindrical part of a bone ; 3. Removal of a part of the bone by completely punching out a portion, thus leaving a hole through the entire substance of the bone ; and 4. Partial fracture, by driving inwards parts of the external cylinder, and causing the fragment to lodge in the cancellated structure. This latter partial fracture is generally attended with lodgment of the projectile also. Among the complete fractures, those attended with general comminution, in the neighbourhood of the part of the bone struck, with dispersion of the fragments among the surrounding soft tissues, and those which may be spoken of as 'resecting fractures,' can hardly be caused accidentally, except by fire-arm projectiles."

From Mr. Longmore's observations, it will be seen that in warfare fractures of bones, as caused by weapons of war, are rarely confined to the ordinary, transverse, oblique, or longitudinal, but are a combination of the whole, or those peculiar to gun-shot wounds.

Considerations respecting the management of Simple and Compound Fractures on the Field.—In arranging for the management of fractures on the field, many difficulties have to be contended with : first, the transporting of patient from field to fixed hospital, then the securing of proper beds, ventilation, and nursing. If an attempt is made to save a limb extensively fractured, and with an external wound, the suppuration which usually follows is so profuse that much difficulty will be experienced in keeping the limb clean and dry, the bandages and splints being constantly soaked with discharge, rendering the air offensive and injurious to health, or inducing pyæmia, which injuries of the bones appear to specially favour in bringing about, also osteo-myelitis and suppuration of the medulla.

With regard to the dressing of compound fractures on the field, Mr. Hennen remarks : "It is questionable if compound fractures could be set at the time of infliction, and the proper apparatus for continued extension applied." In many situations, he says, this is utterly impracticable from the nature of the service. Immediate extension and coaptation are not applicable in all cases, neither are they absolutely necessary to the present

comfort and future safety of the patient. In no instance during his experience did the most skilfully dressed limb on the field preclude the necessity of going over all the steps of resetting, and consequently of redoubling the patient's anguish.

Mechanical appliances are now so perfected that, with the exception of some fractures of the femur, there is no lesion of the bones of the extremities that surgeons need have the slightest hesitation in transporting for considerable distances, prior to inflammatory symptoms setting in, care being observed as to the adaptation and application of splints.

Dr. Stromeyer remarks on this important subject: "Above all things it appears to me to be necessary, that cases of gun-shot fracture of the thigh should not be transported to a distance, but should be carried on a stretcher to the nearest house, and the treatment carried out there, even at the risk that the wounded should fall into captivity."

Gun-shot fractures of the upper extremities are less dangerous than in the lower, circumstances being as nearly as possible alike.

Gun-shot Fracture of Humerus.—Since conservative surgery has been so much practised, it is seldom necessary to remove an upper extremity for injury to the bones as a primary operation. Rare cases, however, require it, as, for instance, when the humerus is broken and splintered into the shoulder joint, the muscles, great vessels, and nerves injured without prospect of their recovering themselves, as in an injury that would occur from a spent cannon-shot or shell striking the arm.

Guthrie remarks: "An upper extremity should not be amputated for almost any accident which can happen to it from musket-shot; and there is scarcely an injury of the soft parts likely to occur which would authorize amputation as a primary operation."

Mr. Longmore considers that "unless the bone be extremely injured by a massive projectile, or longitudinal comminution exist to a great extent, especially if also involving a joint, or the state of the patient's health is very unfavourable, attempts should always be made to preserve the upper extremity after a gun-shot wound."

The experience of the American War gives authority for conservatism in dealing with shot fractures of the humerus, except in most aggravated cases. Drs. Warren and Chisholm in their manuals advise attempts to save the limb even when the fracture is complicated by division of the brachial artery, and M. Legouest considers that shot comminution of the humerus, even when complicated by wound of the brachial artery, does not render amputation "indispensable."

A case is related of a soldier in India receiving a sword cut, which divided his arm, bone and all, with the exception of the vessels and nerves, and the muscles on the inner side, yet he recovered, the bone of the arm uniting.*

* Macleod's "Notes on the Surgery of the Crimean War," p. 304.

Mr. Guthrie recommends that when the splinters extend far into the shaft of the humerus, it may be proper to amputate the whole extremity, especially if the great artery and nerves be wounded; if, however, the head is not injured, the amputation should take place immediately below the tuberosity, and not at the joint, so as to retain the round appearance of the shoulder.

When the shaft of the humerus is much splintered, detached pieces should be removed, fragments of clothing or foreign bodies extracted, points of sharp splinters should be cut off, and the arm placed on a convenient splint, pillow, or cushion, giving it perfect support and rest. For this purpose Dr. Stromeyer has designed a cushion, the utility of which he was so good

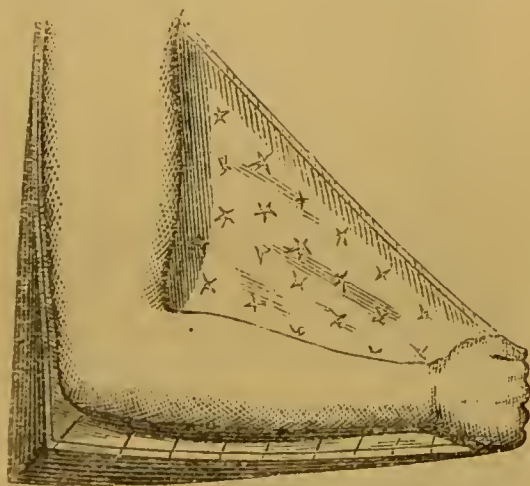


Fig. 95.

as to demonstrate to me at Versailles, during the late Franco-German War. An illustration can scarcely do credit to this admirable contrivance, which affords perfect security and comfort to the injured limb, and with which every army hospital should be supplied.

"The cushion may be described as a right-angled isosceles triangle, 4 inches thick at the apex, which rests against the chest and supports the elbow, the forearm being bent at a right angle with the arm. The cushion gradually thins down till the base is a mere edge, and of the two other angles, one is passed up into the axilla, while the other rests on the chest under the wrist, as represented in fig. 95. The cushion is readily fastened in its place by a tape round the neck, and one round the body, as seen in

fig. 96. When this simple apparatus is applied, the arm rests upon it, beautifully supported, and in excellent position. Whilst lying in bed, nothing beyond the ordinary dressings are required for the wound, and if the patient needs to be transported from one place to another, or is fit to walk about, this can be arranged for with the utmost facility, as cushion, arm, and all can be bound by a broad bandage to the body, and thus form an immovable whole."* Stromeyer informed Dr. MacCormac that so highly

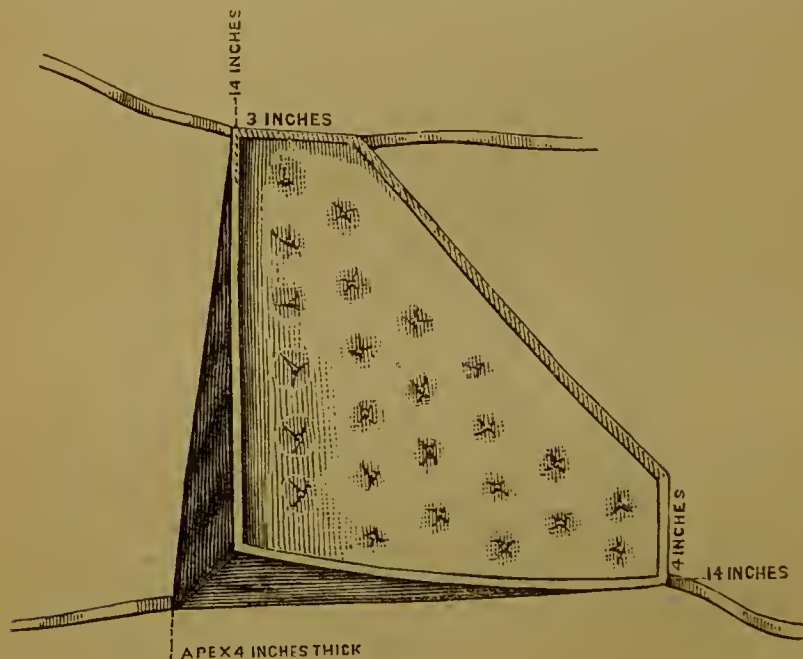


Fig. 96.

did he estimate the value of this cushion, as to consider it the most valuable appliance he had invented during his life. Dr. MacCormac has tried the mode of treatment and found it answer every purpose, and recommends a good-sized cushion, of which the sides measure about 14 or 15 inches in length. I have used this appliance myself, and cannot speak too highly of it, but it requires different measures for different persons.

Hamilton, of the United States Army, in the treatment of gun-shot

* "Notes and Recollections of an Ambulance Surgeon," by W. MacCormac, p. 96.

injuries of the humerus, usually employs a single splint made of felt, leather, or gutta percha, long enough to extend over the top of the shoulder on the one hand, and to the lower part of the elbow on the other, and broad enough to encircle one-third of the circumference of the arm. By moulding, or otherwise fitting the upper part of the splint over the top of the shoulder, it will be prevented from becoming displaced downwards. He considers that bandages have, as a rule, been applied too tightly.

The surgeon cannot be too careful in applying splints to gun-shot fractures of the humerus, as there is great danger in producing gangrene and other unfavourable results when once constriction has been applied too tightly, and the circulation is materially interfered with.

Injury of the head of humerus (vide "Injury of Joints," page 160).

Shot Fractures of the Clavicle.—As in fractures of the long bones, detached splinters should be immediately extracted. Extirpation of the clavicle for shot injury is seldom, if ever, called for.

Shot Fractures of the Scapula.—Bleeding should be arrested. Foreign bodies or detached structures should be removed, and the parts kept at rest by supporting the arm. Burrowing of pus in the dorsal and lumbar regions is a very common complication in these injuries, and should be prevented by free openings.

Shot Fractures of the Radius and Ulna.—The radius or ulna may receive extensive injuries from bullets or fragments of shells, the rule of treatment for such injuries being to remove fragments of bones or splinters, and place the arm on a suitable splint with a view to union taking place; at the same time, passive motion should be adopted early to prevent the bones uniting with one another, thereby rendering pronation and supination imperfect. When both bones are extensively broken, the soft parts lacerated, and vessels and nerves damaged, which often occurs from a bullet passing through both bones across the arm, amputation should be performed, but every endeavour should be made to save a forearm which is well supplied with blood; mortification is consequently not likely to take place.

In the event of amputation being necessary, the surgeon should be careful to leave as long a stump as possible, to which a mechanical contrivance can be attached.

Hamilton suggests that in case both bones are broken, the patient ought to be kept in the recumbent position on the back, with the forearm resting upon a pillow supported by a board, extended and supinated. No attempt should be made to lengthen the limb by apparatus, but daily attention should be given to the position of the bones, and, as far as possible, they should be kept in line.

Shot Wounds of the Hand.—In wounds of the hand, as little as possible of the injured parts should be removed, and, above all, the value of the thumb or a finger should be carefully considered in any operative measures.

In extensive wounds from cannon-shot, or fragments of shell, amputation of the hand may be necessary; but wounds from bullets generally damage one or two metacarpal bones, or may pass between two, only injuring the soft parts.

There may be very troublesome hæmorrhage from wounds of the palm of the hand; this is best arrested by freely exposing the bleeding vessel, by enlarging the wound, and boldly clearing away all coagula. The wound should not be immediately closed.

Shot Wounds of the Metacarpal Bones.—When the metacarpal bones are injured, that is, splintered, the wound should be enlarged and fragments removed, taking care that the tendons are not injured or interfered with, if untouched by the missile. Generally speaking, the extensor and flexor tendons are injured, the result being stiffness of the fingers to which they belong. Guthrie recommends that, when one or more fingers are destroyed, and the metacarpal bones injured, they are to be sawn or cut off, but not removed at the carpus, although an opening into the joint of the carpus will generally do well, if skin can be saved to cover it.

In all cases of amputation of one or more fingers, the metacarpal bones, if injured, should be left as long as possible, and particularly that of the index fingers when the thumb remains.

Shot Wounds of the Fingers.—The phalanges may be broken, when, if in a single finger, a splint composed of wood, gutta percha, or other suitable material, should be placed on the palmar surface of the entire length of the finger, a piece of lint, cotton wool, or other soft texture being first laid against the skin.

If several fingers are broken, the splint should cover the whole palmar surface, the wrist joint being left free.

Incised Wounds of the Forearm and Wrist.—The hand, wrist, and forearm are liable to sword-cuts, which frequently injure the bones or joints. It is seldom necessary to do more than close the wounds, and support the parts by suitable splints.

Gun-shot fractures of the lower extremities are far more dangerous and serious than those of the upper; and as to fracture of the femur, either simple or compound, it will, on active service in the field, cause the surgeon grave anxiety, and perplex him as to the best measures he can adopt, for opinions vary much on this subject.

Shot Fractures of the Femur.—An important question for the consideration of the army surgeon is, What is best to be done for severe gun-shot fracture of the thigh with an army on the move, as transporting a sufferer with such an injury is a very serious matter? Stromeyer is of opinion that it is best to leave the sufferer in captivity. Esmarch is, doubtless, of the same opinion, as, during the Holstein War, he entrusted such wounded to the enemy, rather than allow them to suffer from transport. There are,

unfortunately, occasions where it is not possible to carry out this excellent advice of Dr. Stromeyer, which in European warfare, and under the privileges of the Geneva Convention, should be adhered to. But supposing the contest is with savage tribes, as has lately occurred with the British forces in Western Africa, that the distance is considerable to a permanent hospital, that the roads are bad, and transport indifferent, what, then, should be the course of action?

For a fracture where the bones are simply broken, not splintered, an attempt might be made to save the limb by placing it in the straight position, with a long splint, as recommended by Mr. Samuel Cooper, who in his remarks on Desault's long splint, and referring to his experiences of compound fracture of the thigh during the campaign in Holland in 1814, says: "The superiority of long splints, extending the whole length of the limb, was in these cases particularly manifest. With such splints, which maintain steady the fracture itself, the knee, leg, ankle, and foot, the patient may, in fact, even be moved upon an emergency from one place to another without any considerable disturbance of the broken part."* Since Mr. Cooper wrote the above remarks, plaster of Paris bandages and other appliances have been introduced into military practice, which may prove better expedients.

During the Ashantee expedition, 1874, a soldier of the 42d Highlanders experienced a simple shot fracture of the right femur at Amosful, and by means of a long side splint was safely carried to the port of embarkation; and during the Perak expedition, 1875, two soldiers of the 10th had the lower third of the right femur fractured, but without comminution. Both were safely transported with the aid of ordinary splints.

But a patient suffering from a severe gun-shot fracture of the middle or lower third of the thigh could scarcely be carried a considerable distance over bad roads (such as occurred in Western Africa) without further endangering his life. I am, therefore, of opinion that the chances of preserving life would be increased by immediate amputation, there being no doubt that, to secure success for conservative treatment, the sufferer must not have undergone lengthened transport, fatigue, or privation.

An amputation of the thigh having been performed, the stump can be easily secured for the safe transport of the patient.

In gun-shot fractures of the upper third of the femur under the foregoing circumstances, the surgeon should try and conserve the limb (amputation generally proving fatal), by securing it for transport with a long splint extending from axilla to beyond the foot, and fastening both legs together. Loose splinters of bone should be removed.

The unfortunate sufferer's prospects will, in either case, be very bad, as patients seldom survive such injuries.

* Cooper's "Surgical Dictionary;" Article on Fractures.

Treatment of Gun-shot Fractures of the Femur.—Shot fractures of the femur are attended by extreme danger; the violence that has caused a fracture of such a bone must be very great, the shock to the system considerable, and the prospect of treating such an injury by conservative measures most unfavourable.

Hennen was convinced, after great experience, that the sum of human misery will be most materially lessened by permitting no ambiguous cases to be subjected to the trial of preserving the limb—constitution, convenience for treatment, and local circumstances having their full weight in the decision.

Guthrie, referring to the result of treatment of forty-three selected fractures of the thigh, which were attempted to be saved under his own direction at the battle of Toulon, reports that of this number thirteen died; twelve were amputated at the secondary period, of whom seven died; and eighteen retained their limbs. But he considers the result most unsatisfactory, notwithstanding the care and attention bestowed upon them.

“Nearly all the wounded, after this battle, had every possible assistance and comfort from the second day after the action. The hospitals were well supplied with bedsteads—no inconsiderable point in the treatment of fractures. Every broken thigh or leg was in the straight position, and the success was greater than on any previous occasion. Nevertheless, with all these advantages, there can be little doubt that, if amputation had been performed in the first instance on the thirty-six out of forty-three who died or partially recovered, some twenty would have survived, able, for the most part, to support themselves with a moderate pension, instead of there being perhaps five, or at most ten, nearly unable to do anything for themselves.” The least dangerous and most likely to be saved, he considers, are fractures of the lower third, or at most of the lower half, of the thigh bone; and when they do not communicate with the knee-joint, an attempt ought always to be made to save the limb.

Mr. Alcock remarks on this subject: “I do not agree with Mr. Guthrie;” and though he admits his experience is more limited, still he is of opinion that the expediency on service of ever delaying the removal of the limb with a complete fracture of the femur lower third from gun-shot wound appears to him doubtful. This only refers to soldiers; with officers the results are less unfavourable.

During the Crimean War, the treatment of this injury afforded a subject of great interest. Mr. Longmore informs us that the practice of conservative measures, as a means of preventing amputation, was not encouraging. Of the three modes of treatment, resection was the most fatal, conservative treatment next, and amputation least fatal. The first was uniformly fatal; the deaths among cases treated without operation were 82 per cent.; the deaths among those treated by amputation, almost hopeless cases included, were 65·2 per cent.

In considering the results of gun-shot fractures of the femur, the situation of the injury is a matter of great importance as regards the chances of recovery, whether without or with amputation.

In the official history of the Crimean campaign, this fact is shown in the results of amputation, the recoveries in the upper third being 12·9, in the middle third 40, in the lower third 43·3 per cent. of the cases treated ; but the distinction is not made in regard to the recoveries without amputation.

Stromeyer, who has had great experience, has favoured us with the following opinion:—"I differed from Guthrie in one essential point—that of his preferring amputation for gun-shot fractures of the thigh to conservative treatment. Guthrie puts too much stress upon the imperfections of conservative treatment, the result of which is often a very disabled limb, whose possession does not make the patient very comfortable. But these imperfections admit of improvement, while a high amputation gives no prospect of better chances ; it will always remain a very dangerous operation. Our first object is to save a man's life, and the second to make him comfortable, but not in his grave. My results of conservative treatment in gun-shot fractured thigh during the first three campaigns of 1849, 1850, and 1866, did not go beyond 50 per cent. healed. I saw the reasons of our failures, tried to avoid them, and went on with conservative treatment. In the two campaigns in Schleswig-Holstein (1849 and 1850), the patients had to be carried to considerable distances. After the battle of Lanzensolza, in 1866, I was unable to prevent many cases from being spoiled by an injudicious use of plaster bandage. It was in Floing, near Sedan, where we succeeded in saving 77 per cent., twenty-seven amongst thirty-five patients, who had been carried to no great distance, and were treated without putting much restraint on their shattered limbs.

"According to my opinion, the great principles to be followed in compound fractures in general are:—(1) Dressing the wounds without lifting the limb ; (2) avoiding constriction ; and (3) not irritating the muscles in straining them by mechanical contrivances. A gun-shot fractured thigh permits a weight to be suspended to it, keeping the limb a little at rest, like the hand of an assistant, but not an extension by weight or other contrivance which gives the limb its proper length, except in very few cases.

"The most common case is, that for some time after the accident the muscles retain a tendency to retract which is increased by opposition, and ceases by-and-by in a favourable position of the broken limb.

"The idea of subduing muscular action by constant extension, even in compound fractures, is not new ; but it had not been tried before by contrivances so dangerous as a plaster of Paris bandage. This is applied under chloroform, which relaxes the muscles ; the limb is made straight and as long as its fellow. When the action of chloroform has ceased, the muscles recover their activity, and are kept in extension in spite of their violent

efforts to contract, which often break the plaster bandage. The tension, which is kept up by mechanical means, makes the sensibility rise to a high pitch, and severe inflammation follows. If the plaster bandage be loosely applied, by putting wadding and a flannel roller between, it is often well borne, but the limb is as short afterwards as if no bandage had been employed." *

It appears remarkable that such eminent authorities as Stromeyer and Guthrie should differ on this point; but the fact is, that Guthrie formed his opinion from experiences in Peninsular and Crimean campaigns, where fractures of the femur were treated under circumstances totally different from the experiences of Stromeyer, who in all probability was enabled to secure proper accommodation, food, and attendance for his wounded; whereas, during the Peninsular and Crimean Wars every discomfort and inconvenience that man could be subjected to were present with the British army, which unfortunate circumstance gave conservative treatment the disadvantage.

Pirogoff, in 1849, after great mortality from thigh amputation for gun-shot fractures, was induced to try conservative treatment in ten cases of bad compound fracture of the thigh, which had done well not only without operation, but without treatment of any kind. He was also of opinion that the application of a permanent paste bandage would render the transport of such wounded possible. During the Crimean War he experienced 90 to 95 per cent. death-rate in primary thigh amputations, as did the French; but in the German hospitals, during the war of 1870-1871, more than thirty cases of recovery from gun-shot fractures of the upper and middle thigh were met with; whereas, of thigh amputation only twenty-one survivors were found. and in none of these had the operation been performed in the upper third.

Many military surgeons of the present day appear to consider conservative treatment for gun-shot fracture of the thigh the proper course to be adopted; but there are circumstances where it may not be desirable, as want of proper accommodation, attendance, appliances, exposure to extremes of climate, necessity for moving, under which conditions amputation would most certainly give the sufferer the best chance of recovery.

During the early part of the siege of Sevastopol when wounded were subjected to every discomfort that can possibly be imagined,—when the best bed was a bundle of brushwood, without blankets, in a bell tent on a mud floor, the prospects of treating a compound fracture of the femur conservatively were most unfavourable, and that of amputation little better; but of the two, amputation in the middle or lower third gave the sufferer the best chance. Again, take exposure in a tropical climate, with intense heat, indifferent accommodation, and want of competent nursing, amputation

* Address delivered at St. Thomas's Hospital, London, May 23rd, 1872. "*Lancet*," 25th May, 1872, p. 723.

would no doubt be attended with more favourable results. It is, therefore, only under certain conditions, such as good accommodation, food, ventilation, and attendance, with suitable appliances, that conservative treatment should be attempted.

Dr G. H. B. Macleod (who closely observed these injuries in the Crimea), remarks : "It can hardly be doubted that the great straining after conservatism which influenced all the surgeons of the army was one main cause of the mortality which attended these injuries." Again he says that, "under circumstances of war similar to those which occurred in the East, we ought to try and save compound comminuted fractures of the thigh when situated in the upper third, but that immediate amputation should be had recourse to in cases of like accident occurring in the middle or lower third."

Erichsen considers amputation especially necessary in some of the more serious injuries of the lower extremities. Thus, if a bullet divide the femoral vessels or the sciatic nerve, splinter the thigh bone, or if the sciatic nerve and soft parts at the back of the thigh be carried away, although the vessels and bone be left uninjured, the case is one for amputation ; and, indeed, it may be stated generally (though doubtless there are exceptions to this, as to all general rules in surgery) that all compound fractures of the lower third of the femur occasioned by gun-shot require amputation.

Mr. Hamilton, of the U.S. Army, in his remarks on gun-shot fractures of the thigh, says : "We have not in our possession full statistics of the present war, but sufficient facts have come to our knowledge to indicate that there has been, on the part of our surgeons, a large amount of conservatism, especially in reference to the treatment of gun-shot injuries of the thigh. Our own impression is, that in those injuries conservatism has ruled too much, and that amputations have been too little practised."

To guide the surgeon as to when he ought not to attempt to save the limb, but proceed to amputation at the thigh after a gun-shot fracture, he lays down certain rules, which are as follows :—

When a patient has to be carried far over rough roads, and without adequate support to the limbs.

When the bones are greatly comminuted.

When the patient suffers great pain, or violent spasms continue in spite of opiates and rest.

When the soft parts have suffered great contusion, as in the case of a fracture from solid shot or shell.

When there is very extensive laceration of the soft parts.

When the principal arteries or nerves are involved in the injuries.

When the fracture implicates the knee-joint, or even when it is near the knee-joint.

Under the following circumstances we would not, as a rule, resort to amputation :—

When the ball has entered the head, neck, or trochanteric portion of the femur ; if any surgical operation is demanded in these cases, it is usually ex-section.

When the fracture is just below the trochanters ; experience having shown that very few recover after these amputations.

When the fracture of the femur is caused by a pistol-ball, by a round musket-ball, or by any missile whose force is nearly spent.

It will be understood that the last observation has reference solely to the less degree of comminution which these missiles usually occasion.

The following conditions must be added as essential to the success of conservative measures :—

All pieces of bone which are only slightly attached to the soft parts must be removed.

All foreign bodies, such as fragments of balls or other missiles, pieces of cloth, wadding, &c., must be carefully taken away. Whatever binds or obstructs the external opening, and prevents the free escape of blood or of pus, must be divided or removed.

The limb must be placed in a position of absolute rest, and must remain at rest. It must not be confined by tight bandages, or forcibly extended by apparatus.

If the knee-joint be implicated, it must be laid freely open and placed at perfect rest, without adhesive straps, bandages, or other means of compression.

During the whole treatment, the limb must be handled with great care, and not lifted roughly or carelessly. When sinuses form, the matter must be let out by direct or counter-openings, and not by violent pushing and thumbing.

When spiculæ of bone present themselves they must be removed.

The patient must be supplied with good nourishing diet.

Examination of Wound.—The condition of a fractured femur from a rifle-bullet is always a matter of great obscurity, and it is therefore impossible to decide what steps should be adopted without making a most careful examination with a view to ascertaining the extent of injury.

Stromeyer says that probing should never be done in cases of fractures of the shafts of bones which are intended to be treated conservatively ; and that in operation cases, the examination should be made immediately prior to the operation.

Long and deep incisions may have to be made, and the extent and number of them will depend upon the size and number of the splinters. It has been recommended that the wound of exit is the proper place to look for sequestra, as the ball, in passing through or traversing a limb, naturally carries them with it.

The depth of splinters in muscles is not to prevent incisions being made,

nor should their proximity to large vessels or nerves interfere with a diligent search after them. It is of the most vital importance that they, as well as articles of clothing, the bullet itself, or other foreign bodies, should be removed, and with the least possible delay.

The limb will soon swell, and become very painful, and the longer the operation is postponed the more painful is the case to the unfortunate patient, the more difficult to the surgeon, and the prospect of saving the limb more unfavourable.

Much care will be required in removing small fragments in the after-treatment, and giving free vent to pus both in the neighbourhood of the wound and along the axis of the bone when abscesses form in connection with unobserved splinters.

Sequestra and the Classification of them.—Dupuytren has divided sequestra into three classes, viz., Primary, Secondary, and Tertiary. The primary are those wholly separated; the secondary those partially adherent, probably by a slight piece of tissue; and the tertiary those which become necrosed. There are generally longitudinal sections into which the bone is split, which are sometimes capable of consolidation. The wholly separated portions should be at once removed, as, if not, they soon set up irritation, abscesses, pyæmia, and the usual terrible results.

Some doubts have existed as to the advisability of removing those under the class secondary, or those partially adherent, from the supposed possibility of consolidation taking place; but it is now generally admitted that, in doubtful cases, or in those where the adherence of the sequestra is but slight, it is best to remove it; the chances are so much in favour of its becoming wholly detached, acting as a foreign body, with its painful consequences, that the disadvantages of such a contingent are in no way counterbalanced by the fortunate circumstance of consolidation, which is remote. Guthrie, Roux, Baudens, Legouest, and Begin are in favour of their removal.

The Removal of Sequestra.—Dupuytren recommends that, in searching for sequestra, the wound should be so enlarged as to enable the fingers to pass freely and meet without impediment. Guthrie considers that "the preservation of a femur fractured by a musket-ball, when splintered to any extent, ought only to be attempted if the principal splinters can be removed. When the splinters of the femur are long and large, it has been supposed that if they retain their attachment to the soft parts, they may be placed in apposition and preserved. This may be doubted."

Extension in Treatment of Gun-shot Fractures of the Femur.—In treating gun-shot fractures of the thigh-bone by conservative surgery, most competent authorities agree that it is best to keep up extension to a moderate degree, but, in the event of a portion of the bone being removed, there will be a space

between the broken ends; if, therefore, strong extension is made, the ends of the bone will be drawn asunder, and continued irritation of the muscles and surrounding tissues will be kept up.

To prevent shortening is almost an impossibility; it will, therefore, be best to allow the ends of the bone to approximate, which the muscles will do of themselves, and all that can be done is to keep the limb straight, if possible. The less interference the better.

Stromeyer observes: "Do not be too anxious to remove all the fragments of fractured and displaced bones. Do not be too eager to maintain extension of the fractured limb, and abstain from frequently lifting the fractured limb for the purpose of cleanliness."

Contrivances for the Treatment of Shot Fractures of the Femur and Bones of the Leg and Foot.—(1.) *The Femur.*—While simple fractures of the shaft may be put up in the semi-flexed position of Pott, the straight of Desault and Liston, or the double-inclined plane, or by any of the numerous modifications of either, it is otherwise with the *compound fractures* resulting from gun-shot. Hence, numerous contrivances and apparatus have been invented for the more convenient treatment of shot fractures of the thigh-bone; in fact, any one who has ever had to treat such an injury on service can bear testimony to the difficulties and dangers to be encountered.

Mr. Guthrie considers that "the successful treatment of a gun-shot fracture of the thigh cannot be effected whilst the patient is lying on a little straw, or a mat on the ground, and proper bedsteads should always form a part of the hospital stores of an army in the field. The position of the patient in a gun-shot fracture of the thigh or leg is of the utmost importance. He should lie on his back, and the limb should be straight. It is almost impossible to keep a man's thigh in the bent position, or on its side, without his turning on his back, and the union of the bone, if it take place at all, must then be at an angle. The bent position forward or on an inclined plane is defective, inasmuch as the matter, which must necessarily be secreted in great quantity, will gravitate backward in spite of every care to prevent it."

Mr. Hamilton does not recommend "the long straight splint, with the usual means of extension and counter-extension, in any of its various forms, unless in rare cases. A perineal band can rarely be borne in gun-shot fractures of the thigh, and a long, broad side-splint is always very much in the way of dressings." The method he recommends is, "laying the limb upon the mattress or some sufficiently firm and even support, or on the same or nearly the same plane with the body, making the extension by a weight attached to a cord drawn over a pulley, while the counter-extension is made with the weight of the body, by elevating the foot of the bed. This is the plan, more or less modified, which has been adopted in a large proportion

of the cases which we have seen under treatment ; and, we think, with the best results.

“With the straight position, the limb may rest directly upon the bed, when it is not always accessible for the purpose of dressing the wounds. The limb may be moderately lifted or suspended by a frame and cotton bands.

“When extension is applied, it should be moderate and barely sufficient to steady the limb, or to prevent the ends of the broken bones from pressing into the flesh. For this purpose we apply a broad band of adhesive plaster along each side of the leg, from the knee downwards, and secure these in place with a roller, covering certain portions of the limb with cotton batting before applying the roller, to prevent excoriation. The end of the adhesive plaster should be laid over a small block below the sole of the foot, which

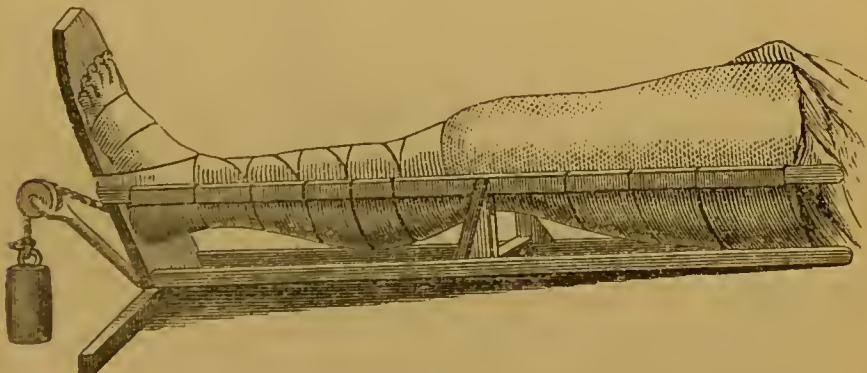


Fig. 97.

block must be of sufficient width to protect the malleoli from the pressure of the bands. A small rope, knotted at one end, is then to be run through a hole in the centre of the block, and carried over a pulley at the foot of the bed. The pulley must be so high that the extension shall lift the heel a very little from the bed.”

Mr. J. T. Hodgen has invented an apparatus by means of which the limb is maintained in a straight position, while at the same time it is lifted from the bed and rendered more accessible (fig. 97). “The apparatus is composed of four nearly parallel bars and a foot-board ; two of the bars constituting the base, and the remaining two, covered by transverse slips of cloth, being intended to receive and support the limb.

“The longitudinal bars are 42 inches long, and the upper bars are elevated $4\frac{1}{2}$ inches above the lower ; the space between them diminishes from the

upper to the lower ends, being 12 inches at the groin, 8 at the knee, and 4 at the foot. The foot-board is 14 inches high, $4\frac{1}{2}$ inches wide, and is supported by a cross-piece or foot underneath, 15 inches long.

“The transverse strips of cloth, each $2\frac{1}{2}$ inches wide, are placed in contact, and adapted to the inequalities of the limb.

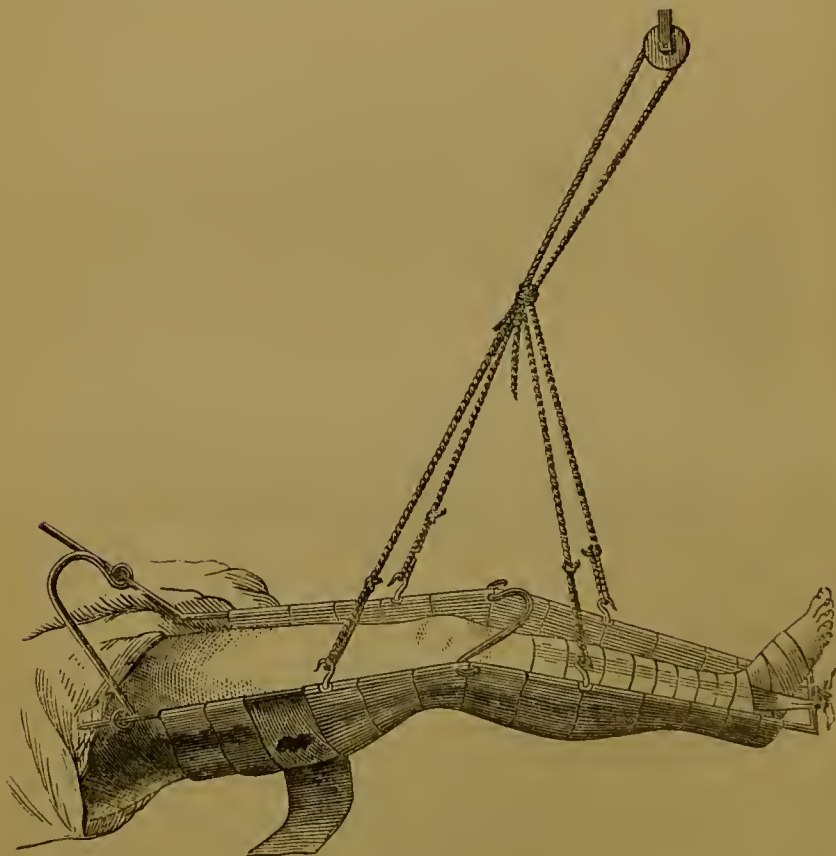


Fig. 98.

“Adhesive straps are secured to the sides of the leg by a roller, and brought around the foot-piece; a cord, to which is suspended a weight, is made fast to the centre of the foot-piece and passed over a pulley, and this constitutes

the extension. The counter-extension is made by lifting the foot of the bed 4 or 6 inches."

Mr. Hodgen has also invented a splint whereby the limb can be suspended, which it appears he has substituted for his own "cradle." "It is made of iron wire (size No. 2), and resembles in many points Dr. Smith's anterior splint, but its mode of application is not the same. Strips of cloth are laid across the splint from side to side, and upon these the limb is laid. The centre and upper extremity of the splint are kept asunder by strong bows of iron wire, so arranged that they can be put on or taken off without disturbing the dressings. When applied, the inside wire must be bent upwards at its upper extremity, so as to make room for the pubes. Extension is made by adhesive plaster, and the whole apparatus is finally

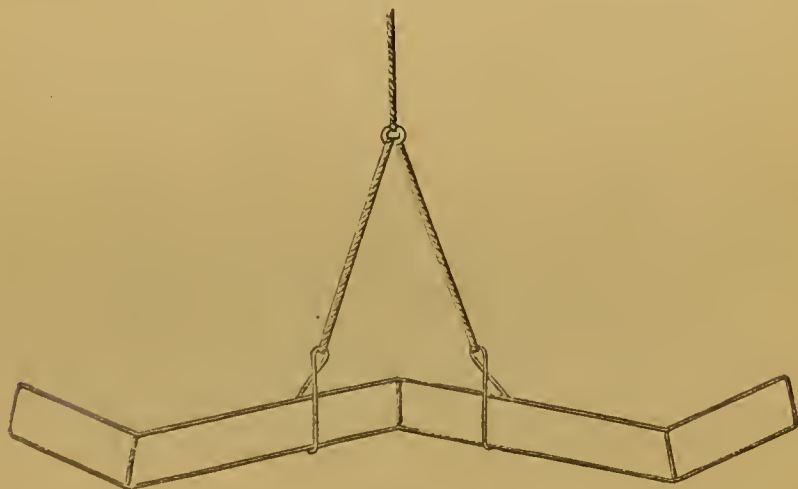


Fig. 99.

suspended to the ceiling, or to some point above, by a rope and pulley" (fig. 98).

Dr. Nathan R. Smith, of Baltimore, has introduced a splint for fracture of the thigh, which no doubt will answer for simple or compound injuries. It is a double-inclined plane, made of wire, and intended for suspension. The splint is placed above the limb instead of underneath.

It is composed of a frame made of stout wire (size No. 10), (fig. 99). Its length should be sufficient to extend from the anterior superior spinous process of the ilium, to a point beyond the toes, the lateral bars being separated 3 inches at the upper end, and 23 inches at the lower end. Before being used it is covered with cotton cloth, to protect the limb from

immediate contact with the wire. The limb is then secured to the splint by successive turns of a roller from foot to groin (fig. 100).

When this splint is applied to a broken femur, one of the hooks, to which the suspending cords are attached, should be made fast to the splint about opposite the seat of fracture, and the other should be secured a little above the middle of the leg; while the point of attachment in the ceiling, or to the frame from which the suspension is made, should be a little in advance of the knee, and not perpendicularly above it; this will secure a certain amount of extension and counter-extension upon the thigh.

The principal objection to this splint is the difficulty of applying it and the roller from time to time, without disturbing the limb at the seat of fracture. The limb is also liable to be bent at the point of union.

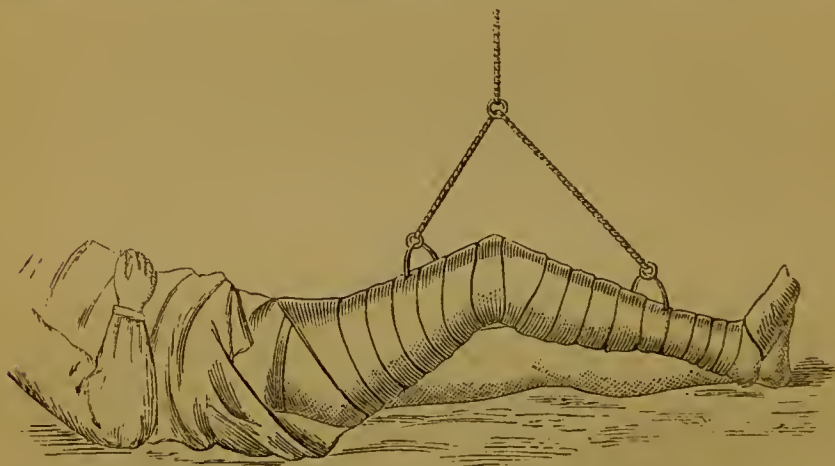


Fig. 100.

Professor Esmarch, in his work on bandaging (1866), describes a splint for gun-shot fractures of the thigh, which is very easily made, portable, and can be used for placing the limb in a straight or double-inclined position. It consists of two planks, on which the upper and lower leg are to be laid, and which are united by two hinges. There is a third plank, to which the plank to support the thigh is attached by means of a hinge, and which admits of movement to any angle of the thigh and leg planks. To keep the foot firm, there are two 10-inch pegs, which, with a bandage, are connected with one another to form a foot support, so that the foot can be pressed against it. Similar, but smaller, pegs are placed in the sides of the plank, fixed on both sides, so as to keep the pads in position. If it is necessary

to raise the foot, a brick should be placed under the apparatus at that end (figs. 101 and 102).

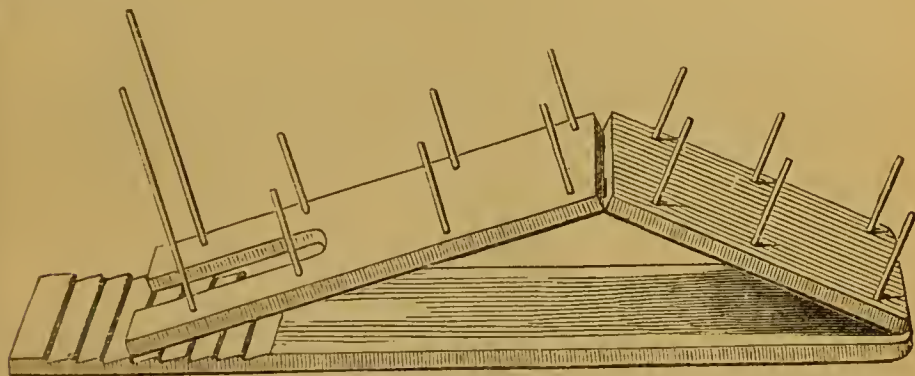


Fig. 101.

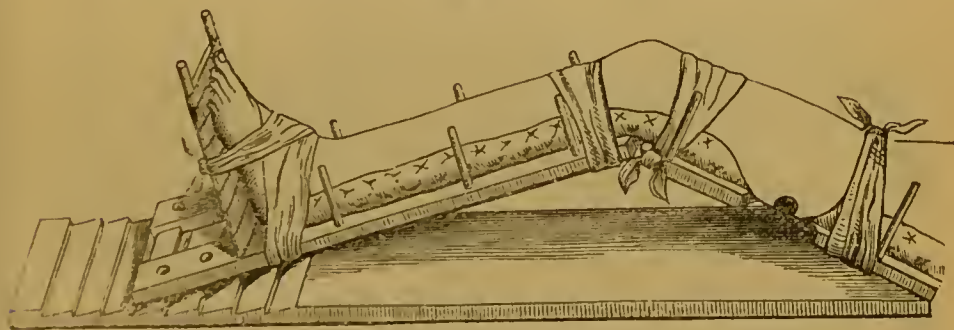


Fig. 102.

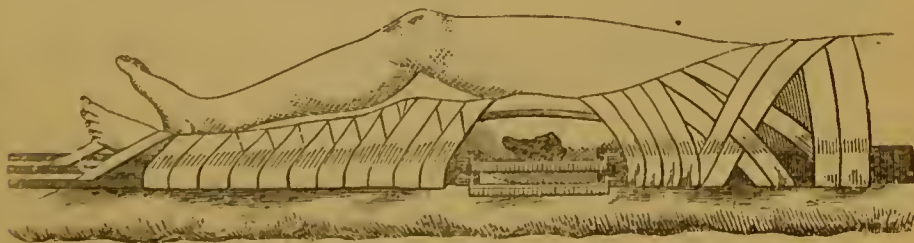


Fig. 103.

It is of the greatest importance to make a good slit for the heel in the splint for lower leg, to avoid pressure.

In compound fractures, where the aperture exists in the posterior and outer part of the limb, Erichsen has found a long splint, made of oak, and bracketed opposite the seat of the injury, the most convenient apparatus, enabling the limb to be kept of a proper length and the wound to be dressed at the same time (fig. 103).

Surgeon-General Gordon describes the "appareil Bonnet" which he saw used in Paris during the siege (fig. 104). He says: "It is, perhaps, the

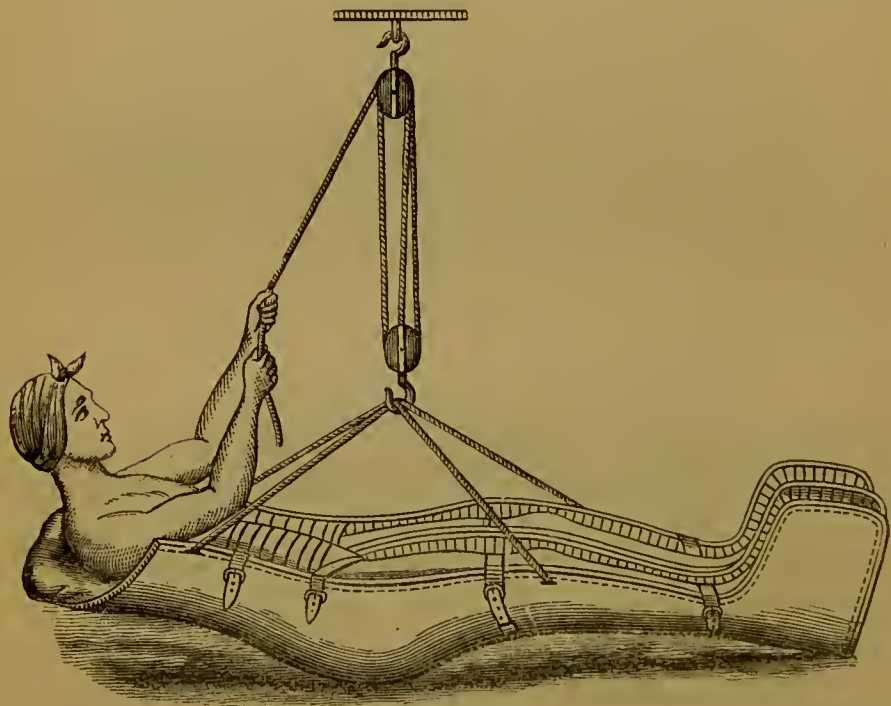


Fig. 104.

best and most convenient kind of apparatus for treatment of gun-shot wounds in the lower extremity." The sketch will illustrate its construction and mode of application.

"A very short time is sufficient to enable a workman so to modify the apparatus that a piece may be taken out and secured upon movable hinges, to enable the surgeon to attend to the wound, whatever be its position, the apparatus having an opening in which the nates rest. For fractures of the

femur it is very convenient. The position of the perineal belts is seen in the illustration, and extension at the foot may readily be ensured by means of straps secured to buckles at the end of the foot-pieces or to the bedstead."

Professor Esmarch, in speaking of the *appareil Bonnet*, says they are convenient for the treatment of fractures of the lower extremities, but that they are expensive; that they take up much room; and that it is difficult to have a sufficient number of them of different sizes.

Professor Stromeyer has designed a fracture box, which may be used for fractures of the thigh or leg, but appears best suited for the latter (fig. 105).

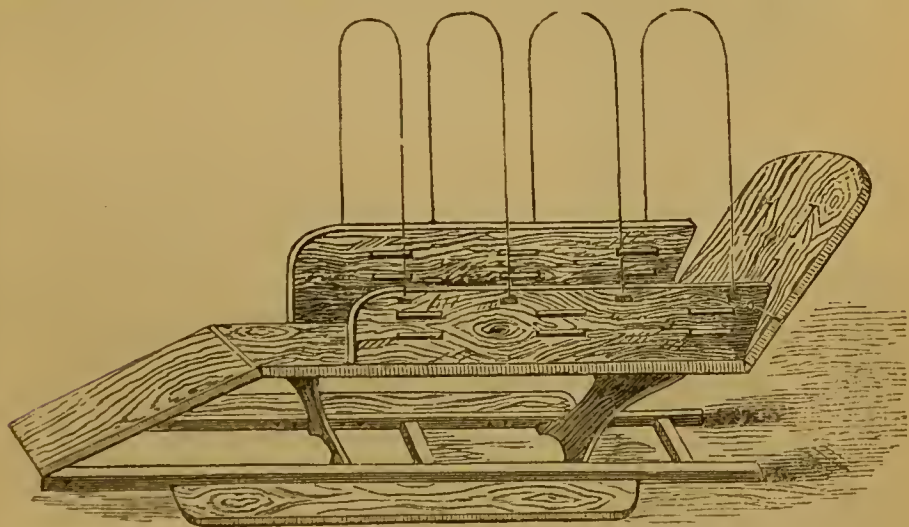


Fig. 105.

It consists of a double-inclined plane, supported on a frame, with hinged brackets, which can be moved so as to place the box at a convenient angle.

The thigh-piece, sides, and foot-board are attached to the bottom of the box by hinges, and so constructed that all fold into one convenient package.

The sides and foot-board are perforated to admit of bandages being passed through. An intelligent carpenter should be able to make an apparatus of this kind in a short time.

Legouest gives an account of an apparatus for fractures of the thigh designed by Sarazin, which he says has all the mechanism for extension and counter-extension. It is composed of metal gauze for enveloping the foot, leg, thigh, and pelvis, and is fashioned to certain shapes, so as to fit the limb accurately (fig. 106).

Placed on the inside of the limb, but outside the gauze, is a long wooden

splint divided into two portions at the level of the knee, but joined by

means of an iron plate fixed to the lower portion, which works in a mortise in the upper portion (fig. 107), where it can be secured with a strong screw. By means of this contrivance extension can be made from the lower limb, and maintained by tightening the screw.

The splint and gauze are kept in position by means of the belt round the pelvis, and several straps with buckles round the limb, the straps being secured to the wooden splint by means of flat-headed nails. In applying the splint, the limb should first be enveloped with cotton wool. Should the apparatus not be found sufficiently strong, it may be supplemented with a splint passed under the straps. The gauze is easily cut by strong scissors or with a mallet and chisel on a hard plank; after which the edges should be turned up to prevent fraying, or they may be bound with leather.

Should there be a wound, an aperture may be cut in the gauze for the purpose of cleansing the wound and applying dressings; but this is scarcely necessary, it is so easy to open the apparatus without disturbing the limb.

Fig. 108 represents the different parts of the apparatus, with measurements for a man of ordinary height.

(2.) *Gun-shot fractures of the leg-bones—tibia and fibula*, uncomplicated with injury to great vessels and nerves, or when the knee and ankle are not implicated, admit of an attempt being made to save the limb; splinters should be removed, and irregularities sawn off, if necessary.

Guthrie recommends that the leg should be placed in the straight position on the heel as a general rule, admitting of few exceptions.



Fig. 107.

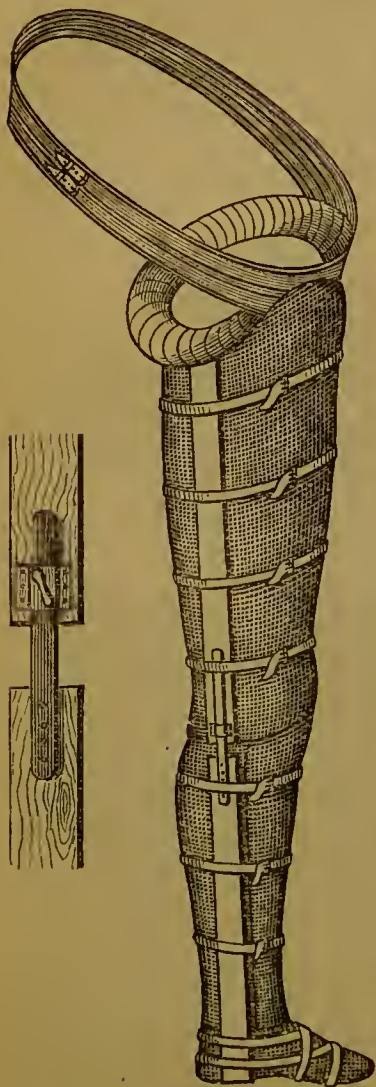


Fig. 106.

placed in a fixed hospital, he will derive great comfort from a common box splint with sides, so arranged with hinges that they can be let down to examine the wound without disturbing the limb. If the flesh wound is not extensive, the limb may be put up with the ordinary side splints with pads, and the whole placed in "Salter's Sling."

The limb may also be placed on the double-inclined plane of McIntire, which appliance answers on service for fractures of the thigh as well, and with a firm bed gives great ease and comfort to the sufferer.

Mr. Hamilton is of opinion that, when both bones are broken completely asunder by a rifle-ball or other large shot, the surgeon will not often find it prudent to attempt to save the limb. "In general," he says, "the comminution is even greater than in fractures of the femur. If an attempt is made to save the limb, loose floating fragments must be removed and the limb placed in an easy position, being sustained by moderate lateral pressure. Neither extension nor counter-extension can generally be made to any purpose.

"It is impossible to lay down any absolute rules as to the position which the limb should occupy; sometimes the fragments will be found most at rest when the leg is made straight upon the thigh; but in the large majority of cases the position of moderate flexion will be required, the limb either resting upon its side, as recommended by Pott, or upon its posterior surface, as is most generally practised.

"Whatever form of apparatus may be used, the foot will require always the support of a foot-board, and the heel must never be permitted alone to sustain the weight of the foot." He recommends "a box containing bran, as suggested by Barton, of Philadelphia, as being specially convenient in warm weather, when maggots are apt to infest suppurating wounds. A box constructed for this purpose should be 2 or 3 inches longer than the leg, measuring from the middle of the knee, and 3 inches wider than the diameter of the limb at its widest part.

"To prevent the bran from escaping, a piece of cloth longer than the leg, and about 2 feet wide, should be laid inside the box, the bran to be poured into the cloth until the box is about one-third full; upon this the limb is to be carefully placed in a straight position, and the free upper extremity of the cloth being pinned snugly round the thigh, just above the knee, the bran must be again poured in on each side of the limb, in contact with the skin, and packed with the fingers. If the wound is covered with lint previously spread with simple cerate, the bran may envelope the whole surface."*

In compound fractures of the tibia, occasioned by direct injury, as by a kick from a horse, which is not an uncommon accident in the mounted

* Hamilton's "Military Surgery," pp. 415. 416.

branches of the service, it is most injudicious to attempt to heal the wound by placing on it a piece of lint soaked in blood, as it only becomes hard, and prevents the escape of matter, which invariably follows such an injury, and if checked sets up irritation and inflammation; the limb becomes swollen and painful, irritative fever supervenes, and relief is not given till the wound is opened and there is free evacuation of the discharge.

"Hæmorrhage," remarks Mr. Erichsen, "is a common complication of compound fracture of the leg. When venous and moderate in quantity, it may be arrested by position and cold. When arterial and abundant, proceeding from laceration of one of the tibials, the line of practice to be adopted must to a great extent be determined by the situation of the fracture and of the concomitant arterial wound. If these be anywhere above the lower third of the limb, it is useless for the surgeon to attempt to secure the bleeding vessels by groping amongst and under the deep muscles of the limb, infiltrated and disorganised as they are by the injury and by extravasation. It is equally futile in these cases to ligature the superficial femoral artery; such an operation either fails in arresting hæmorrhage, or, if it stops the circulation sufficiently for this, gives rise to gangrene. There is, consequently, no resource but amputation, and the sooner this is practised the better will be the patient's chance of recovery."

(3.) *Wounds of the Foot and its Bones.*—The bones of the foot, when injured by rifle-ball or other missile, present, as a rule, serious complications—being numerous, of soft texture, and liable to run into a state of caries from the slightest injury.

There may be injury of some of the many tendons, of the vessels, nerves, and strong fascia.

It is difficult to extract splinters or foreign bodies, and, if the injury to the bone is extensive, an attempt to save the foot is not recommended, as the disease produced will ultimately render amputation necessary, which, if done at first, would prevent much suffering. When it is decided to interfere by operation, the foot, or part of it, should be removed as soon as possible.

A missile will sometimes lodge in one of the bones forming the foot, doing but slight injury to the surrounding textures. An attempt should then be made to remove it or the bone.

Shot Wounds of the Os Calcis.—The heel may be struck by cannon shot or bullet, only destroying a portion of the os calcis. By due attention in removing spiculae of bone and making free openings for the exit of matter, the limb may be preserved.

Wounds of Bones of the Toes.—In wounds of the bones of the toes, only such as are extensively fractured, or when the tendons and vessels are torn, should be amputated. Much can always be done by removal of splinters of the bone, foreign bodies, and strict antiphlogistic treatment.

Shot Wounds of the Toes.—Wounds of toes are generally in connection with other injuries to the foot, but when separate, and requiring removal, only those injured should be amputated. It is of the utmost importance to preserve the big toe even when circumstances necessitate its being left alone.

WOUNDS OF JOINTS.

In the treatment of gun-shot wounds of joints, much of the success will depend upon the size and description of joint (wounds of ginglymoid joints being considered more dangerous than ball and socket, and more liable to be followed by tetanus), the extent of injury done, the age and constitution of the sufferer, and the time after receipt of injury that treatment has been commenced, and the available means for carrying out that treatment.

Mr. Alcock divides the prospect of success in such injuries into three divisions, which are as follows, and which embrace most important circumstances for the consideration of the surgeon :—

1. Favourable circumstances: Cases admitted into a large, well-organised, and commodious hospital an hour or two after the injury was inflicted, and then treated to the end, under the same medical superintendence and with all essential means for good treatment.

2. Partially unfavourable circumstances: Cases not immediately received into a well-organised hospital, subjected to some leagues of transport, or passing part of the first period in a field hospital with deficient means, or received into a permanent hospital with lax discipline.

3. Unfavourable circumstances: Cases admitted into crowded hospitals with epidemics prevailing; means, either personal or material, not fully adequate; with cases of wounds inflicted after a reverse in the field, or long subjected to deficient means, discomfort, and imperfect discipline of temporary field hospitals, with one or two days' subsequent transport to permanent hospital station.

Patients who have undergone excision or resection require constant care and attention, abundant cubic space, and pure air; every facility for securing cleanliness, proper dieting, nursing, surgical skill, and most perfect rest. The suppuration, as a rule, is always copious, and there is great susceptibility to pyemic poisoning. It is, therefore, necessary to calculate as to the possibility of securing favourable conditions before resection or excision is elected in preference to amputation,—this operation not requiring the same amount of attention in the after-treatment, or the same prolonged rest and confinement indoors.

Professor Hannover, of Copenhagen, is not favourable to the operation of resection of joints. In his writings, he says that he has formed his opinion on the cases he has seen among the Danes who were wounded during the

war between Germany and Denmark in 1864, and being one of the members of the Pension Committee, has had an opportunity of annually inspecting these cases. "In the majority of instances the patients reported to be cured were left with useless dangling limbs, and the Danish surgeons, as well as the patients, both agree that amputation would have been preferable; for it would have saved the latter from being burdened with limbs which are not only cumbersome and powerless, but also sources of frequent pain, atrophy of the extremity in which the resection has been performed, coldness, numbness, and contractions."*

Professor Hannover's remarks have been reviewed, and the reviewer naturally points out that most surgeons must be familiar with some cases in which not only full use of the hand and fingers has been retained after resection of one of the large joints of the upper extremity, but considerable power in certain movements of the whole limb. Even one such successful instance is sufficient to annul a general condemnation of the operation itself.

Dr. Loeffler, of the Prussian Medical Military Service, who, it appears, operated in some of the cases referred to by Professor Hannover, says that in various instances the Professor has relied upon certificates furnished by surgeons in different parts of Denmark, not for scientific purposes, but with the object of showing the necessity for a continuance of the pension to the invalided soldiers who had been the subjects of the wounds which led to the operation of resection.†

It is quite possible, as Dr. Loeffler suggests, that the same attention may not have been given to the after-treatment as in Germany, and that the climate of Denmark is not very favourable for patients after resection.

Stromeyer is in favour of primary operations for resections, and does not approve of allowing cases for primary resection to drift into secondary, in order that they may be performed subperiosteally. He considers the advantages of the subperiosteal resection to be exaggerated.‡

Mr. Erichsen, in his valuable work on surgery, gives the following as indications for excision:—

1. Excision may be required in bad compound dislocations and fractures into joints, especially in gun-shot injuries, more particularly in those of the head of the humerus and of the elbow.

2. As a substitute for amputation in cases in which the joint is so extensively diseased that the patient will be worn out by the discharge or pain unless it be removed. Here a useful limb may be secured by the sacrifice of the diseased part.

3. In some cases of articular disease, in which amputation would not be justifiable, excision may be performed in order to hasten the cure, and thus to save years of suffering to the patient.

* "British Medical Journal," January 15, 1870.

† *Ibid.* May 28, 1870.

‡ *Ibid.* September 23, 1871.

4. Excision may be performed in cases in which amputation is not practicable, as in disease of the hip-joint or of the temporo-maxillary articulation.

5. As a substitute for other and less efficient treatment, in order to restore the utility of a limb or joint, as in osseous ankylosis of the elbow, or in faulty osseous ankylosis of the knee.

Legouest considers that "the indications for excision are—when the lesions of bone are limited and the vessels are intact, when the lesions of the soft parts are to small extent, and when it is possible to preserve a certain number of muscular insertions round the joint."

WOUNDS OF THE SHOULDER-JOINT.

All wounds of the soft parts in the proximity of the shoulder-joint are deserving of the greatest consideration. Neudörfer specially remarks on this, and says: "It occurs that wounds which do not open the joint primarily injure the same to such an extent, that in a short time complete suppuration of the joint ensues." An obscure case of this group occurred in a soldier of the 23d Regiment, who was wounded during the Ashantee expedition of 1874. A leaden slug entered the head of the left humerus, without fracturing the bone, or opening the capsule of the joint, or causing much primary irritation; five months subsequently inflammation and suppuration of the joint set in, for which I performed excision of the head of the bone. (See *Army Medical Reports for 1873*.)

Should the joint be laid open by a sabre cut, or slightly wounded by a rifle bullet, the soft parts not much lacerated, no large vessel or nerve wounded, and the constitution of the sufferer good, the wound ought to be closed with the least possible delay, and by careful attention and dressing, and keeping the limb at perfect rest, recovery may take place. Tight bandaging of the arm or any constricting apparatus should be carefully avoided, as tending to induce gangrene by interfering with the circulation. Should the head of the humerus be splintered, the articulating surface injured, the soft parts only slightly damaged, and no wound of great vessel or nerve, the operation of excision is advocated, which in the hands of British surgeons has been found most successful, and has given the sufferer a comparatively useful limb.

Professor Longmore records, during the Crimean War, that of thirteen resections of the shoulder-joint in the English army, there was only one death; eight of these were primary and five secondary operations; and that, during the New Zealand campaign, several resections were performed with remarkably successful results.

Partial excision of the head of the humerus may be performed, but the results heretofore have not been altogether satisfactory. In the Reports of the American War, fourteen cases of partial excision are recorded, in seven

of which the arm was useless. In the same reports cases are given in which, 3, 4, 5, and even 6 inches of the shaft of the humerus as well as the head were excised, some of the patients recovering with fair power of the hand and forearm, and others without any impairment. Mr. Otis in analysing the treatment of 2328 cases of wounds of the shoulder-joint, arrives at the following conclusion :—

1. That in slight shot injuries of the shoulder-joint an expectant conservative treatment is justifiable.

2. If a ball is impacted in the head of the bone, or if the epiphysis is much comminuted, unless there is injury to the blood-vessels and nerves, or very grave injury of the other soft parts, primary excision should be practised.

3. Concomitant fractures of the acromial end of the clavicle, or of the neck or processes of the scapula, or of the upper third of the shaft of the humerus, do not necessarily contra-indicate excision of the shoulder.

4. Intermediary excisions should seldom or never be practised. If in an attempt at expectant conservative treatment, intense suppurative inflammation arises, it should be combated by free incisions, drainage, emollient applications, etc., and every endeavour should be made to avoid inflicting another wound upon the inflamed medullary tissue, and to await the second stage before undertaking operative interference.

5. The after-treatment of securing comparative immobility and support of the limb and efficient drainage of the wound, and the ulterior after-treatment of judicious passive and active movements of the arm, are of essential importance in restoring the functions of the member.

WOUNDS OF THE ELBOW-JOINT.

Punctured and incised wounds of the elbow may usually be treated on the expectant conservative plan, with every hope of recovery, reserving secondary excision until rendered necessary by inflammatory disorganisation. The bones forming the elbow-joint may be slightly injured by sabre cut, bullet, or fragment of shell. In the event of the external wound being slight, and the bone only partially damaged, that is, splintered about the condyles, olecranon, or radius, or if a bullet or other foreign body is lodged in the lower end of humerus or condyles, it will be necessary to remove splinters or fragments, elevate foreign body, close the wound, and follow out a strictly antiphlogistic treatment. The joint will in all probability be stiff, but the patient will have the advantage of a forearm and hand; and here it is that experience may do so much in saving a wounded soldier from excision or amputation. By careful examination with the finger immediately, or as soon as possible after receipt of injury, the exact condition of the joint may be ascertained, and the necessary operative measures at once carried out.

Guthrie observes: "When the articulating ends of the humerus, radius, and ulna are wholly or in part injured by a musket-ball, it was formerly the custom to amputate the arm in such instances of great mischief; an operation which should be superseded by that of excision of the joint."

Excision of the elbow-joint, in the hands of British military surgeons, has been attended with most happy results. The writer has seen some useful limbs after the operation, capable of lifting weights, and unaccompanied by pain or numbness.

The Period of Election for Excision of the Elbow.—We have it on the authority of Heyfelder and other experienced surgeons, that, as in amputation after shot wounds, a favourable result of the operation is so much more to be expected the earlier the resection is performed.

Amount of Bone to be removed in Resection.—By the experience recorded in the Reports of the American War, the doctrine has been confirmed that complete resections give more favourable results both in preserving life and utility of limb than a partial resection. The removal of the head of the radius, or of one of the condyles, or the upper extremity of the ulna, is more liable to be followed by inflammation, extensive and prolonged suppuration, or by ankylosis, than the removal of the entire joint. Some doubt, however, exists as to such line of treatment when the joint is exposed, the ligamentous attachments freely divided, and the injury is confined to the lower end of the humerus. Is it safer to saw off the injured extremities of the radius and ulna, or if the joint ends of the bones of the forearm are injured to remove the condyles of the humerus?

In disease Mr. Syme recommended the removal of the articular extremities. In operations for injury, Mr. Otis appears to consider *a priori* that there is not the same object in inflicting additional injury by a section of healthy bone, and the deduction seems to be sustained by facts, excellent results having been obtained when the joint ends of either the upper or forearm have been removed after complete exposure of the joint, and the uninjured portions of the articulation have been unmolested.

An interesting and instructive case is recorded by Mr. MacCormac (*British Medical Journal*, January 22, 1876), in which a soldier during the Franco-German War received an injury of the shoulder and elbow on the same side, in which he excised both joints with most satisfactory results.

WOUNDS OF THE WRIST-JOINT.

The wrist being a complicated joint, gun-shot injuries to it are liable to be followed by most serious results, and, as the structures are so superficial, *resection as a primary operation* is not likely to be successful. Its close connection with flexor and extensor tendons renders them liable

to consolidation with their sheaths, and thus to cause stiffness of the joint.

Sword cuts opening into the joint, if seen early should be cleaned, the soft parts brought together by means of sutures, and the hand and forearm supported on a splint, until firm union has taken place, when flexion and extension should be exercised to try and avoid a stiff joint.

M. Legouest makes the following important observations regarding recent wounds of the wrist. Shot fractures of the wrist, where the region is traversed in its long diameter, and is the seat of much shattering (*délabrements*), require amputation in the forearm. Where the joint is perforated from before backwards, without great disorders, by extracting splinters the limb may be preserved.

Resection as a Secondary Operation.—Mr Longmore remarks that, with rare exceptional cases of gun-shot wounds of the wrist in which the superficial structures have escaped, there is no reason why resection should not be attended with the same excellent results that have attended the operation when performed for conditions of disease.

Of six complete excisions of the wrist during the American War, one proved fatal after recourse had been had to amputation. The five others recovered with the functions of the hand much impaired, but, all things considered, in a better condition than if they had been subjected to amputation.

Mr. Lister has endeavoured with most happy results to render the operation of excision of the wrist successful, and his operation should, if practicable, be selected, being least liable to injure the important structures near the joint. His recommendations for after-treatment should be attended to.

The Expectant Treatment.—In selecting cases for this method of treatment, the surgeon must be guided by the amount of destruction of soft parts and bone, bearing in mind M. Legouest's practical hints. From the experience of the American War injury of one of the large arteries complicating these fractures, was not always regarded as an absolute counter indication of expectant conservative treatment. In 707 cases treated on the expectant method, confined abscesses occupying sheaths, bursæ, and synovial sacs, and leading to extensive adhesions and contractions, were amongst the most frequent complications.

Inflammation should be moderated by cold applications; the parts should be supported without constricting bandages, upon a padded splint. Free incisions should be made to relieve inflammatory tension, when suppuration has taken place. Movements of the fingers and hand should be commenced as early as practicable.

When the wrist is so severely injured as to preclude all hopes of saving it, amputation through the joint may be had recourse to.

In applying bandages to the wrist, the fingers should be left free, and occasionally moved to prevent ankylosis.

GUN-SHOT WOUNDS OF THE HIP-JOINT.

These wounds are without doubt the most dangerous of all joint wounds. They are difficult to recognise ; they are frequently not discovered through want of proper care, and the immobilisation of the joint, which is the chief requisite for successful treatment of joint wounds, is more difficult to carry out than with any other joint. Add to this, remarks Professor Langenbeck,* that the capsule of the hip-joint, in almost all its extent, is closely surrounded by the strongest ligaments and by thick muscular layers ; it is far less elastic than the articular capsule of the knee-joint ; and an accumulation of wound secretions may occur in the disproportionally compressed joint, which favours their absorption in the highest degree, and the more so as the hidden position of the joint, and the displaced muscular masses, render any discharge impossible through the wound opening. For these reasons, symptoms of septicæmia in these wounds appear much earlier than in wounds of other joints.

Military surgeons in former days looked upon gun-shot wounds of the hip-joint as simply hopeless, and considered that the wounded died, except in very rare cases, just as much after one mode of treatment as after the other. Mr. Hennen makes these observations : " Injuries occasioned by balls lodging near or about the joint of the hip are amongst the most serious in military surgery ; the fever, the profuse discharge, the tedious exfoliation, all tend to sink the patient, and are but too often fatal. In some of these the course of the ball is so obscure, and its place of lodgment so uncertain, that it can only be detected after death." These remarks entirely bear out the experience of most surgeons of the present day, but the mortality statistics of the war of 1870-1871 give evidence that hip-joint injuries are not absolutely hopeless, and an endeavour should in consequence be made to try and bring about even more happy results either by judiciously conducted conservative treatment in properly selected cases, by excision of the joint or removal of splinters, or by amputation.

Conservative Treatment.—Langenbeck has pointed out that some gun-shot wounds of the hip-joint, and even most severe cases, may be cured by conservative treatment ; that the surgeon should decide after the first examination if conservative treatment be admissible, or if operative interference must be resorted to ; hip-joint wounds should therefore be quickly recognised, or weighty difficulties offer themselves ; and whatever plan of treatment is adopted, it should be carried out in a rational manner from the moment of injury. He gives 88 cases of gun-shot wounds of the hip-joint

* Professor Von Langenbeck's remarks on these injuries are taken from his " Surgical Observations on Gun-shot Wounds of the Hip-Joint," translated by J. F. West F.R.C.S., Birmingham, 1876.

treated conservatively during the Franco-German War of 1870-1871, in which 25 were cured and 63 died, equal to 71·59 per centage of deaths, against 31 treated by resection and extraction of the head of the femur, in which 4 were cured, 26 died, and 1 was doubtful, equal to 83·87 per centage of deaths.

For conservative treatment he first selects all the lighter hip-joint injuries, in which it is impossible to determine the exact diagnosis directly after wounding; simple capsule wounds, to which category alone belong all those which have involved the articular capsule from the margin of the acetabulum downwards, to the trochanter major and minor, where it only loosely surrounds the head of the femur.

He lays great stress on the importance of conservative treatment, even when the bladder and rectum are implicated, or complicated injuries of both organs exist. Extra-peritoneal gun-shot injuries of the bladder and rectum must not be considered altogether as the most severe wounds, supposing they are carefully treated, and it is difficult to understand why the danger of hip-joint wounds should be so greatly increased by these complications.

Cases in which Conservative Treatment is not applicable.—According to Langenbeck's way of thinking, conservative treatment should not be adopted either for intra- or extra-capsular fractures of the neck of the femur, if the continuity of the bone is quite destroyed.

As recovery from these wounds hardly ever occurs without suppuration in the joint, consolidation of the fracture must be looked upon as impossible, and necrosis of the head of the femur, at all events in intra-capsular gun-shot fracture, as unavoidable. We must therefore, he says, consider that complete separation of the neck of the femur and splintering of the head and neck of that bone should be excluded from conservative treatment, and that resection or extraction of the head should be performed either primarily before the expiration of the first twenty-four hours, or directly after the expiration of the infiltration period, and before suppuration commences.

Mr. Otis,* in referring to conservative treatment, considers it is to be condemned in all cases in which the diagnosis of direct injury to the acetabulum can be clearly established.

To carry out conservative treatment with the possibility of success, Langenbeck considers it should not be merely expectant, as to how the wound may perhaps end, but that from the moment of the injury the most active care should be exercised and persevered in until long after the healing of the wound.

The first and most important task is the immobilisation of the joint, and the suitable position of the patient. The wounded should therefore be left in the nearest field hospital, the first immovable bandage should be applied on the battlefield, and so arranged that the probable unavoidable further transport to the first station of the army hospital, and perhaps on the

invalids' railway waggon, may be undertaken without great injury to the wound.

A plaster of Paris bandage well put on, surrounding the pelvis and the entire extremity, would best answer these requirements, but as they are troublesome of application, and require much time and too many experienced hands, Langenbeck does not recommend them during a great battle, but suggests flat hollow splints, passing round the back of the pelvis and of the entire wounded extremity, leaving the fore part of the hip-joint free. He also speaks in favour of the "zinc tablets" suggested by Dr. Schön of the Austrian army.

Permanent extension by means of a weight is of the greatest importance. Active probing of the shot canal is objectionable, especially when it has been decided to treat conservatively, as it must impair the chance of a favourable healing of the wound. With regard to extraction of bullet, he is of opinion that if it is perceived in the neighbourhood of the joint, its extraction is necessary. Bone splinters, if they lie quite loose in the wound, may be extracted, especially if they are likely to interfere with the shot canal, or prevent the discharge of secretions from the wound. Repeated vigorous attempts to take bone splinters out of fresh wounds are altogether inadmissible. Free incisions are of the greatest importance for letting out blood which may be retained in the joint, or collections of matter may be emptied with the most gratifying results. Ice is recommended in Germany, in the treatment of recent joint wounds. The French surgeons usually place leeches close to the recent wound, and later on warm cataplasms.

Excision of the hip-joint for gun-shot wounds was performed in the Crimea, in the Schleswig-Holstein campaigns, during the American War of the Rebellion, and during the Franco-German War of 1870-1871, but the result with few exceptions was far from satisfactory, due in many instances to the want of proper means for carrying out the after-treatment. Yet till Professor Langenbeck published his experiences, as compared with conservative treatment, it was advocated for certain wounds in preference to conservative treatment, and with suitable means for the after-treatment one cannot but think it would be preferable, seeing the splendid results which the operation sometimes affords in civil life.

Excision was first recommended by Mr. Guthrie as a substitute for amputation at the hip-joint; he limited the operation to injuries of the head and neck of the bone, or with little extension beyond these parts.

Mr. Hamilton, U.S.A., considers that when a ball has entered the head, neck, or trochanteric portion of the femur, if any surgical operation is demanded in these cases, it is excision.

Mr. Otis gives three periods for performing the operation of excision of the hip-joint, with the following rules:—*Primary* excision should be performed in all uncomplicated cases of gun-shot fractures of the head and

neck. *Intermediate* excisions are indicated in similar cases, where the diagnosis is not made out till late, and also in cases of gun-shot fractures of the trochanters with consecutive arthritis. *Secondary* excisions are demanded by caries of the head of the femur, or secondary involvement of the joint resulting from fractures in the trochanteric region, or wounds of the soft parts in immediate vicinity of the joint.

These three periods he defines thus:—*Primary*, those performed in the interval between the reception of the injury and the commencement of the inflammatory symptoms, a period rarely exceeding in duration twenty-four hours, but it may be prolonged to thirty-six or forty-eight hours. *Intermediate*, those performed during the persistence of the inflammatory stage, a period extending over two or three months. *Secondary*, those performed after inflammation has subsided, when the local lesions have become analogous to those resulting from chronic disease.

Langenbeck considers excision should be performed for intra- or extra-capsular fractures of the neck of the femur, if the continuity of the bone is quite destroyed. The operation is demanded where there is splintering of the head and neck of the bone; and when gun-shot fractures of the acetabulum cause accumulations of matter in the pelvic cavity, it is an urgent indication for resection of the head of the femur.

To ensure success for this operation, military surgeons should endeavour to perform resection at the same time as primary amputations, and never defer the operation *beyond the first day*; after that time they must wait for suppuration of the wound and decline of the fever.

Amputation at the hip-joint for gun-shot wounds, notwithstanding its great mortality, cannot be altogether discarded. Mr. Guthrie laid it down as a principle that in all cases of accident, whether from shot, shell, or railway carriage, no man should suffer amputation at the hip-joint, when the thigh bone is entire. Cases requiring it are:—those in which a wound of the artery is accompanied by a fracture of the femur, or in the event of the principal artery being wounded during the course of treatment, or its not being possible to saw the bone through immediately below the trochanter major, and when sufficient flaps cannot be preserved to close the wound thus made.

The following rules as regards amputation at the hip-joint, which are laid down by Mr. Otis, appear highly practical:—(1) When the thigh is torn off, or the upper extremity of the femur comminuted with great laceration of the soft parts, in such proximity to the trunk that amputation in continuity is impracticable; (2) when a fracture of the head, neck, or trochanters of the femur is complicated with a wound of the femoral vessels; (3) when a gun-shot fracture involving the hip is complicated by a severe compound fracture of the limb lower down, or by a wound of the knee-joint. There are two other possible contingencies under which primary or early intermediate coxofemoral amputations for injury may be admissible: (1) when, without

fracture, a ball divides the femoral artery and vein near the crural arch; (2) when a gun-shot fracture in the trochanteric region is complicated by extensive longitudinal fissuring as to preclude excision.

Langenbeck, in referring to the dangers of amputation at the hip-joint, gives as a prime cause the lateness at which the operation is usually performed after receipt of the injury. He considers it should not be done during the period of infiltration, or after pyæmic or septicæmic symptoms have appeared, but that the proper period is in the course of the first twelve to twenty-four hours. If, however, the right moment for disarticulation is neglected, resection is admissible, as the only means of saving life, with a view to disarticulation being performed later, when the patient is in more favourable circumstances.

Symptoms of Gun-shot Fractures of the Hip-joint.—With complete separation of the head or of the neck of the femur, the symptoms are the same as fractures of the neck of the thigh in civil practice. Discharge of synovia is represented as being absent more frequently than present; this is peculiarly remarkable in wounds that go direct into the joint from the groin, but not with those where the wound aperture lies further back; the absence of synovia, however, does not prove that the hip-joint is uninjured. Langenbeck lays down as one distinct sign the swelling of the articular capsule by blood and synovia, ichor and pus, which is most plainly witnessed in the neighbourhood of the groin, where the articular capsule is superficial. Analogous symptoms to those witnessed in the coxitis and exarthrits in civil practice will be found in the stages of inflammation and suppuration.

Gun-shot wounds of the trochanter, and injuries of the soft parts near the hip-joint, require the greatest care, even when there is no evidence of the joint being injured, because the subsequent inflammation and suppuration may ultimately extend to it. The trochanter major, remarks Professor Langenbeck, as the projecting point in the outline of the thigh, shows the centre of the hip-joint, so the bullet may lodge in the joint if it is projected in that direction. The dilatable bone substance allows the bullet to press forward into the joint without leaving behind a shot canal that will fairly admit the probe, and one is too easily led to believe that the ball has passed through or fallen out of the apparently shot canal.

It is now considered good practice in gun-shot wounds of the upper part of the femur, when the fracture does not extend beyond the trochanter, or is in the trochanter itself, to simply remove the splinters and observe absolute rest for the patient.

WOUNDS OF THE KNEE-JOINT.

Wounds of the knee-joint are most serious. The admission of air into a large sac, lined by synovial membrane, producing inflammatory action; the

missile probably injuring the cartilage and bony structures; the drain on the constitution by profuse suppuration, with, in all probability, diarrhœa, hectic and blood poisoning, render these injuries beyond hope of recovery without surgical interference.

The treatment generally admitted as being the best is that of amputation, but there are some few advocates for conservatism or resection.

Mr. Hennen, after his great experience, says: "In my own practice I have met with only two cases where the limb was saved after serious injury to the knee-joint, and in one of them only was the perfect use of it restored."

Mr. Guthrie considers that "wounds of the knee-joint from musket-balls, with fracture of the bones composing it, require immediate amputation; for although a limb may be sometimes saved, it cannot be called a recovery, or a successful result, where the limb is useless. For one limb thus saved ten will be lost."

Mr. Longmore speaks of gun-shot wounds of the knee-joint as being of the most hazardous nature. He is of opinion that the proper treatment of a penetrating gun-shot wound, when the diagnosis has been satisfactorily established, is generally a matter of serious doubt and difficulty. The necessity of amputation, when the articulating ends of either or of both of the two principal bones are broken, in addition to the joint being penetrated, has hitherto been generally recognised and acted upon in field practice. But the ratio of mortality in amputations at the lower third of the thigh has frequently led surgeons to resort to other modes of treatment. Resection has been tried, but with comparatively little success in field practice.

Dr. Macleod, who appears to have taken a special interest in this class of wounds, visited every one he could hear of in camp while in the Crimea, and avers that he never met with one instance of recovery in which the joint was distinctly opened and the bones much injured by the ball, unless the limb was removed.

Dr. Stromeyer recommends primary amputation for gun-shot injuries of the knee-joint. He is not in favour of resection, and is thus opposed to Professor Langenbeck, whose system is non-interference.

M. Legouest doubts whether resection of the knee can ever be substituted as a general rule for amputation of the thigh in army surgery. Amputation is so serious a matter, that he does not hesitate to renounce it, and to have recourse to resection under certain conditions—that is to say, when the wound is slight; when the sufferer is young and healthy; when he need not be carried any distance; when he may be placed alone in salubrious air, with all the resources of surgery and hygiène. These conditions, he says, are unhappily very rare in campaigning, and the impossibility of combating them retards the possibility of resection in the surgery of war.

Gordon mentions that during the siege of Paris the experience gained seems to have confirmed the correctness of the rule that amputation should

be performed in all cases of penetrating wounds of the knee-joint; at the same time it showed the impracticability of making it absolute, there having undoubtedly occurred some cases in which deviation from it took place with every prospect of saving the limb, although the patients had, in the first period of treatment, to suffer a degree of inflammation and subsequent suppuration that seriously jeopardised their lives.

So impressed is Mr. MacCormac with the necessity of amputation in gunshot wounds of the knee clearly implicating the articulation, that he says there is no rule in military practice where there can be less doubt.

Excision of the knee-joint is an operation which should not be attempted unless under the most advantageous circumstances; when every possible care and attention can be given to the after-treatment; when the patient can have good air and diet, and every appliance that the surgeon may require. These circumstances are not likely to exist in the field, though they may be available in stationary hospitals.

The safest course to adopt is to amputate at the lower third of the thigh, and the sooner it is done the better, as inflammatory symptoms soon set in after such injuries, followed by suppuration of the joint; abscesses appear among the muscles of the thigh, burrowing along the bone after depriving it of its covering; the patient rapidly becomes exhausted by hectic, when interference by amputation will be too late.

When the end of the femur has not been injured, it has been proposed to amputate at the knee, leaving the bone intact; this has not been found a successful operation, as it has been attended with great suppuration, constitutional disturbance, and prolonged suffering.

Should an attempt be made to save the limb, the treatment should be strictly antiphlogistic by the application of cold and leeches to the joint; which should be kept perfectly fixed. Langebeck recommends plaster of Paris bandages. There should be no pressure. Wounds should be enlarged to admit of free discharge. The diet should be good and the air pure.

It has been proposed to freely incise the joint, based on the result of accidents in civil life, where the joint has been extensively opened and very little harm followed; but what little experience we have on this subject is most unpromising.

When a ball is lodged in the joint, Mr. Guthrie is of opinion that an attempt should first be made to try and extract it without extensively opening the joint; if that is not possible, amputation or excision had better be performed. If, he says, a ball lodge in the condyles of the femur within the capsular ligament, and cannot readily be extracted, the wound should be healed as soon as possible, and although it may cause some little inconvenience to the knee-joint, the limb and the life of the patient may be saved.

In incised wounds of the knee-joint, if not complicated, it is best to try and save the limb, by bringing the edges of the wounds together by means

of silver wire sutures ; exclude the air, and keep the joint at perfect rest. Instances are on record of recovery from such injuries.

WOUNDS OF THE PATELLA.

The patella is occasionally fractured with a bullet or other missile, and if complicated with injuries to the other bones it will be impossible to save the limb. Should, however, the patella be struck in front and only split, an attempt should be made to save the limb.

In all injuries to the patella the limb should be placed in the straight position, with a well-padded splint underneath, and heel slightly raised.

WOUNDS OF THE ANKLE-JOINT.

In these injuries much depends on the amount of damage done to guide the surgeon in the treatment. If the bones are not extensively injured, and the posterior artery and nerves intact, an attempt should be made to save the foot ; but, like all injuries to joints in which the surgeon might wish to save the limb, and indeed where it might be considered advisable, the circumstances as regards care, attention, &c., as already described, should influence him.

Stromeyer, in wounds of the tibio-tarsal articulation, recommends the expectant treatment. He is opposed to resection of this joint, which was not successful in the war of 1870-71. His plan of treating gun-shot wounds of the ankle is simply to keep the parts perfectly immovable, and extract the pieces of splintered bone as they become detached.

Langenbeck is in favour of resection, which operation he performed with success in the German-Danish War of 1864, and the Bohemian War of 1866. He has had nine recoveries out of eleven operations. He recommends subperiosteal resection, and complete immobilisation of the parts after the operation.

Erichsen considers that if the bones be not too extensively comminuted, an attempt, and probably a successful one, may be made to save the limb. In such cases extraction of fragments and excision of the splintered ends are necessary ; and modified operations, partial excision by means of gouge, forceps, and Hey's saw, will be found more successful than the formal operation.

If the large vessels and nerves have been cut across, and the bones very extensively shattered, amputation will be the proper course to pursue.

Legouest admits that there are many instances of success when resection of the ankle-joint has been performed, but considers that the seriousness of lesions of this articulation, the danger of the operation, and the uncertainty of definite results, justify him in rejecting resection of this joint in a general way, as he has already rejected that of the wrist.

WOUNDS OF NERVES AND TENDONS.

NERVES may be injured by contusion, compression, or distension, by laceration, by partial or whole division, by puncture or incision. Foreign bodies may be imbedded in them, or they may be included in a ligature, any of which may give rise to most serious symptoms, both local and constitutional—such as intolerable pain, inflammation, contraction of muscles, or tetanus.

Treatment.—If exposed, the parts must be thoroughly cleansed, and all foreign bodies removed that may be present, healing by the first intention being promoted, and perfect rest secured to the sufferer.

Should a nerve of any consequence be cleanly divided, its ends may be brought together by means of a fine cat-gut ligature, with every prospect of its functions being restored.

The local application of leeches, fomentations with poppies, poultices, or cold applications to the neighbourhood of the wound, will vary according to the sensations of the patient, as some will appreciate heat, and others cold. It may be necessary to administer purgatives.

When the inflammation runs high, benefit may be derived from antimony, opium, or hyoscyamus, the antimony being in sufficient quantity to keep up a state of nausea.

After a wound has healed, the cicatrix may press on a nerve and cause great suffering. Friction and gentle exercise may relieve the symptoms. Warren has dissected the nerve from such a position, without dividing or otherwise injuring it.

The local application of belladonna, chloroform, aconite, blisters, subcutaneous injection of sulph. morphia or of sulphate of atropia in the proportion of $\frac{1}{2}$ gr. and $\frac{1}{4}$ gr., the administration of mercury, or division of the nerve may be tried.

Dr. Weir Mitchell considers it is as well to remember that the presence of the torture which accompanies chronic neuritis induces a lowered vital tone which requires tonics and support, and that sometimes the long use of opiates has a depressing effect, which we shall be wise not to forget.

Tendons may be divided by sword-cut or other sharp weapon, or ruptured by over-exertion, when it will be necessary to place the limb in such a position that the muscles may be relaxed, and so approximate the divided ends. When union has taken place, the suppleness of the parts should be restored by friction and warm sea-water douches, for, if neglected, stiffness and weakness of the limb may continue for a long time.

When the tendo-Achillis has been cut or ruptured, an apparatus may be constructed by placing a strap, like a dog-collar, above the knee, from which

a cord is attached to a loop in the back of a shoe or slipper; by tightening the cord the muscles are relaxed.

When the exterior tendons of the fingers are divided, the hand must be placed in the straight position by being laid on a splint.

ANÆSTHESIA.

Chloroform.—The use of chloroform as an anæsthetic in mitigating the sufferings of wounded men and of patients undergoing operations, has been admitted by all as one of the greatest blessings.

When possible, it should be administered for all operations, and for dressing wounds when the subjects are very sensitive, the usual precautions being adopted as regards the wishes of the patient, the condition of the circulation, respiration, and having at hand means for using artificial respiration, galvanism, ammonia, and a forceps or hook for drawing the tongue forward. The experience of the writer is that recently wounded soldiers are very easily placed under the influence of chloroform, much more so than chronic cases, and that it decidedly relieves the nervous shock. Recently wounded require no preparation for its administration, but in chronic cases it is always best not to give food for two or three hours beforehand; but a little stimulant, such as wine or brandy, about half an hour before the chloroform is administered.

As a guide to complete anæsthesia, Bryant lays down the rule that, "when the upper eyelid can be raised without muscular resistance, and no muscular contraction is caused by touching the cornea, the patient is, as a rule, sufficiently under the influence of the anæsthetic for surgical purposes."*

Dr. Snow considers that "chloroform may be given with safety and advantage to every patient who requires, and is in a condition to undergo a surgical operation. A state of great depression from injury or disease does not contra-indicate the use of chloroform. This agent acts as a stimulant in the first instance, increasing the strength of the pulse, and enabling the patient, in a state of exhaustion, to go through an operation better than if he were conscious."

Chloroform and other anæsthetics should be most carefully treasured by the army surgeon, and no waste allowed. It is sometimes difficult to procure it in sufficient quantity, especially after severe engagements, when every drop is worth its weight in gold.

Ether is now much used by the Americans, and has obtained the credit of being much safer than chloroform. It has, however, two great disadvantages, which are, that it requires a large quantity to produce anæsthesia; also, a bulky instrument for its administration—both of some consequence on active service. I have frequently used the drug, with Mr. Morgan's and

* "The Practice of Surgery," by Bryant, p. 1019.

Mr. Ormsby's inhalers, and found it highly satisfactory. Mr. Ormsby's apparatus is less wasteful and more portable than any I have seen.

Ether having the reputation of being safer than chloroform, it is a matter worthy of consideration whether the inconvenience attending the weight and bulk of the inhaler should prevent its being used in time of war. Our combatant brethren never hesitate to transport enormous implements of destruction!

Shock.—The constitutional disturbance which takes place on a man being wounded is described as a shock. This differs in severity in different subjects, being influenced by moral character, intelligence, state of health, and nature of wound. It has also been stated that conical bullets from a rifle cause greater shock than round. As a rule, the greater the injury the more intensified the shock. At the same time there are examples of very severe wounds, and but little shock, and *vice versa*. Mr. Guthrie mentions a case of a soldier at Talavera, who was struck on the head by a 12-pound shot, which drove some bone into, and some brain out of his head. He was walking about, complaining but little, immediately after the accident, although he died subsequently. My experience is, that all wounded suffer to a greater or lesser extent from shock, which manifests itself in feebleness of pulse, cold perspiration, change of colour, and disquietude of mind; the more aggravated form, where large joints are injured, long bones fractured or cavities opened, being fainting, mental agony, loss of reason, convulsions, hiccup, vomiting, irregular chills, sense of weight, collapse,—all of which are most unfavourable symptoms, and their continuance sufficient to cause great alarm.

The shock may not be established for some little time after receipt of injury, an interval which differs in duration, mainly in accordance with the severity of the wound, the agency by which the injury has been inflicted, and probably the constitution of the patient.

The treatment consists in administering consolation or encouragement, cordials, beef tea, wine, or brandy.

AMPUTATION.

UNDER this heading will first be considered the question as to the proper period for performing amputation for wounds requiring it in warfare: secondly, cases demanding it; and, thirdly, the most approved methods of operating.

As to the proper period for amputating, the subject has been pretty well discussed and exhausted years ago; but in an essay like this it may be as well to give the opinions of some competent authorities:—

Ambrose Pare considered amputation should be performed while the wounded were in sight of the battle-field.

Wiseman recommends to cut off the limb while the soldier is heated and in mettle.

Hunter is of opinion that amputation should not be performed until subsidence of the first inflammation. He probably formed his opinion from cases occurring in civil practice.

John Bell, writing in 1800, after describing wounds in which the loss of the limb is inevitable, says, "Amputation should, in those cases where the limb is plainly and irrecoverably disordered, be performed upon the spot."

Mr. Hennen remarks, in his work, 1818: "The propriety of amputation in the field being admitted, the question naturally suggests itself, What is the proper period—instantly on receipt of the wound, or consecutively? The practical reply is, with as little delay as possible." He, however, further on, qualifies this by saying (referring to the surgeon), "But he will betray a miserable want of science indeed, if, in the crowd of sufferers, he indiscriminately amputates the weak, the terrified, the sinking, and the determined. While he is giving his aid to a few of the latter class, encouragement and cordials will soon make a change in the state of the weakly and terrified. When, therefore, he finds a patient with feebleness and concentration of pulse, faintness, mental agony, loss of reason, convulsions, hiccup, vomiting, irregular chills, with stiffness of the whole body, universal feeling of cold and numbness, with sense of weight, change of colour, and other symptoms of collapse, he waits patiently for a return of life—he administers wine, warmth, and cordials."

Mr. Longmore considers that, in respect to the particular time at which primary amputation is to be performed, the general practice of the present day is, when the operation is inevitable, to perform it as soon as it can be done, provided the more intense effects of the "shock," where it has supervened on the injury, have passed away.

Mr. Guthrie is of opinion that when the wound of an extremity is of so serious a nature as to preclude all hope of saving the limb by successful treatment, it should be amputated as soon as possible; and, further, the advantageous results of primary amputations, or those done within the first twenty-four hours, or at most forty hours, over secondary amputations, or those done at the end of several days, or of three or four weeks, have been so fully and firmly established as no longer to admit of any dispute.

In the German medical service, primary amputations are discouraged at the bandage places on the field of battle; which the writer believes to be in consequence of an operation of the kind taking up so much of the surgeon and attendants' time, when other wounded might be relieved, and not from any want of appreciation of the value of primary operations.

There is no doubt that to perform primary amputation or resection for all cases requiring them on the field, would necessitate a very large staff of

surgeons, and consequently these operations can but seldom take place at the first line of surgical assistance.

Amputations in warfare have for a very long time been divided into primary and secondary, by which is understood amputations performed immediately after receipt of wounds, or at an indefinite period, without reference to condition of the patient. Mr. Alcock has introduced a third period, "the intermediary." These have been accepted by many surgeons to denote periods in which amputation may or may not be performed, but with reference to local conditions.

He defines the three periods as follows :—Primary, or the period between the receipt of the injury and the appearance of inflammatory symptoms; intermediary, or the period when the inflammatory action has commenced, and is more or less capable of disturbing the animal economy; secondary, when the violence of the inflammatory symptoms and sympathetic fever have abated, that is, when the suppurative stage is fully established.

Mr. Hamilton divides the periods into immediate, primary, secondary, and intermediate. The first period, or immediate, are those which are made immediately, or within a very short time of the receipt of injury. The term cannot with propriety be applied to amputations made after the lapse of ten or twelve hours. Primary amputations are those made during the first twelve, twenty-four, or thirty-six hours; but not until after the severity of the shock has passed off, or more or less complete reaction has taken place in the general system. Secondary amputations are those made after the inflammation consequent upon the injury has in some measure, if not altogether, subsided, when suppuration has commenced, or even at a much later day.

The intermediate period, or that intervening between the primary and secondary periods, he calls the period of congestion or of inflammation, and points out that the dangers of amputation at this period cannot be overestimated.

With regard to the first period of Hamilton, or that prior to the "shock," it has been denied by some surgeons that any shock follows a wound sufficient to prove a bar to operative measures being carried out. This opinion has been advocated by Dr. Hutchinson and other medical officers of the navy; but in their service wounded men are seen immediately after receipt of injury, and before the symptoms of the shock have been established, whereas, in the army, the surgeon may not see the sufferer for several hours, when in all probability he has endured much suffering, and may be more or less prostrated.

Mr. Macleod has observed several instances in which the shock was delayed, the depressing influence not being felt until some little time after the injury. Mr. Hamilton says that he has never met with these examples, except when some visceral lesion, or the rupture of a large blood-vessel, has

accompanied the accident; he does not, however, deny that the nervous agitation may be delayed in some cases, but is of opinion that the condition is a rare phenomenon.

The fear of amputating, or, in fact, performing any operation for relief of a wounded soldier, in consequence of nervous agitation or shock is, in the opinion of the writer, much exaggerated. With one exception, he has never seen the great depression so often described, and this solitary case was that of a soldier suffering from shell wounds of both knee-joints received in the trenches before Sevastopol.

It is now generally admitted that when amputation is necessary, it should be performed at once, the condition of the sufferer being duly considered—that is, if the shock exists to an alarming extent, it is best to delay the operation, and administer cordials, apply warmth to the extremities, and wait till reaction is established; but if it be not very intense, the operation can be performed, under the influence of chloroform, with the most satisfactory results. Macleod remarks, with regard to the use of chloroform, that by its use the fear of intensifying the shock is obviated.

Amputations after inflammatory action has set in have been attended by most unsatisfactory results. Legouest remarks on his so-called *Période Médiate*: “It is certain that a man who is operated on the day after he was wounded is not in the same state as if the amputation had been performed immediately after the accident; he suffers more or less mentally as well as physically; but the appearance of fever is a pathological phenomenon of great importance, which marks between the period of immediate and mediate amputation a line of demarcation which it is impossible to confound.”

Operations or examination of wounds should never be performed during the period of inflammation, when the constitution is in a most unfavourable condition for such undertakings, and more liable to induce pyæmia or osteomyelitis.

John Bell remarks on this subject: “You must never amputate during pain, fever, convulsions, great swelling of the limb, but most especially during high-coloured inflammation, which betokens approaching gangrene; when the disease is in the constitution.”

Secondary amputations are not so successful in military as in civil practice, when the operation is generally performed for disease and not for injury. In warfare the cases requiring it are—profuse hæmorrhage, which does not admit of the ordinary measures of suppression; gun-shot fractures, when the bones do not unite, and the patient is worn out with suppuration, irritation, necrosis, caries, and all the painful accompaniments of a shattered and useless limb; and cases when traumatic gangrene has attacked a severely contused limb.

Patients who have been subjected to secondary amputation should be

placed in most favourable hygienic conditions ; their constitutions having already suffered renders them peculiarly liable to the occurrence of pyæmia, sloughing, and phagedæna.

CASES DEMANDING AMPUTATION.

In wounds of extremities these cases will be found described according to particular regions, but here they will be considered generally. *Cases demanding amputation*, then, are as follows :—

When a bone is fractured and there is laceration of the main arterial trunk supplying the limb, provided the vessel cannot be tied;

When there is a fracture complicated with destruction of the principal arterial and nervous trunks occurring in the course of a large limb;

When a whole limb is carried off, a ragged stump merely being left;

When there is a comminuted fracture, accompanied with extensive lesion of the soft parts, or with rupture of the principal artery and nerve;

When a limb is completely crushed and disorganised;

When there is a compound fracture of a large limb, with rupture of the principal artery and nerve;

When the principal vessels and soft parts have been carried away, though the bone be uninjured;

Gun-shot wounds involving the interior of the knee-joint.

Extensive injuries of the shoulder, elbow, wrist, and ankle-joints, may require amputation ; but unless there is splintering into the shaft of the long bones, loss of soft parts, or injuries of the principal artery and nerve, resection or excision should be performed.

DIFFERENT METHODS CONSIDERED.

Amputation and disarticulation may be performed by the circular method, the oval method, or by flaps of different shapes, and by skin flaps with a circular cut through the muscles.

Much discussion has taken place as to which is the best plan during warfare. The circular method was generally practised by the German surgeons during the Franco-German War, and was attended by satisfactory results.

Esmarch prefers the circular incision, as the arteries are cut transversely, while by the flap operation an oval opening is made in the vessels, and it might easily occur that the whole lumen of the vessel was not included in the ligature.

To decide as to the most suitable form of operation, much will depend upon the position of the sufferer, as in a permanent hospital there is no reason why flaps including muscles should not be made, the great objection

to them in the field hospitals being the weight and liability to displacement in transport, causing the wound to open, and in all probability their own loss from sloughing. The operations recommended for injuries when an army is moving are skin flaps and circular cut through the muscles. The advantages of these operations are—that the flaps are not so liable to be displaced in transport; there is less care required in the after-treatment, and it has been suggested by many authorities that the skin forms a better covering to the end of the bone than muscle, and is more in accordance with nature, none of those parts of the body where there is most pressure having other covering than skin. The late Mr. Teale practised amputation by the rectangular flaps, the anterior being long and the posterior short. The disadvantages of this plan of operation consist in the necessity of sawing the bone at a higher point when one long flap is made, than when two shorter ones of equal, or nearly equal, length are fashioned.

In gun-shot wounds, it appears especially unsuited, as in many injuries requiring amputation good double flaps may be formed from the soft parts, and a joint saved. Take, for instance, injuries below the knee or elbow, in which, if one long anterior flap is formed, it must be at the sacrifice of the joint and the consequent increased risk to the life of the sufferer by high amputation.

DOUBLE AMPUTATION.

It sometimes occurs that a soldier has two limbs so severely injured that amputation of both is necessary. The writer had an opportunity, during the Crimean War, of seeing one instance of this description of injury, in which he performed amputation of one leg above the knee, while his colleague removed the other shortly afterwards.

Double amputation has been performed at the same time by different surgeons, with a view to lessen the continuance of shock to the system by simply making one operation; but to undertake anything so serious, the surgeon must be guided by the condition of the patient, as, if he is greatly depressed with continuance of the shock, the performing of a double amputation might be followed by most serious consequences. Under such circumstances, it would be better to remove one limb first, and after the shock produced by the operation had passed off to remove the other. There is no doubt, however, that if the sufferer could bear the double operation at the same time, the prospects would be more favourable.

Amputation performed in an atmosphere disinfected by Lister's carbolic spray may be attended by most favourable results, but in the field such advantages are not always procurable; and if they were, there might not be found time to use them. In permanent hospitals, the process should be strictly carried out.

WASHING OUT OF STUMPS.

The need for washing out clots from stumps and cavities immediately before closing them, cannot be too strongly brought to the notice of the surgeon, more especially in warm climates, where they very rapidly decompose, and cause most injurious effects.

During the Crimean War, the late Professor Porter, of Dublin, observing the great mortality from amputation, requested the writer to try the effects of washing out each stump before closing it, taking care that no clot remained. This was done by a stream of water from the spout of a kettle or an ordinary wine bottle, and with most satisfactory results both in the Crimea and India.

Very few stumps heal throughout by the "first intention"; but the irrigation process gives them a better opportunity for doing so, and when the surgeon comes to dress the stump, he will find it free from clots, which keep up irritation and by infective decomposition poison the patient.

AFTER-TREATMENT OF STUMPS.

The after-treatment of stumps in the field does not differ from that usually carried out in civil practice. The simpler the dressing the better, but there are advocates for complex dressings, such as with strips of linen saturated with a solution of the perchloride of iron, as recommended by Dr. Gaurveau. Dr. F. S. Dennis reports favourably of the treatment of stumps by the open method.

It may be necessary to transport an unfortunate sufferer with a stump or stumps only recently made. The surgeon will then have an anxious time in so arranging that the patients are not unnecessarily knocked about. The stump should be supported by a piece of thick gutta-percha or strong board being placed underneath and secured, and the whole enveloped in cotton wool or tow. It is surprising how soldiers recently operated upon bear transport, and what very slight injury is caused by it, due attention, of course, being paid to the nature of the conveyance and efficiency of the attendants.

FLIES.

In camp and tropical hospitals, the greatest care is required to counteract the persistent efforts of these insects to deposit their ova in wounds, and to prevent the generation of larva in them.

Most rigid attention should be paid to the immediate removal of all dressings and bloody cloths, whether dry or recently stained; cleanliness about the patient's person, the ward, and the hospital should be enforced;

particles of food should be removed, and offal and refuse buried. Wounds should be protected by light gauze thrown over the dressings.

MAGGOTS IN STUMPS.

In warm climates maggots are very apt to infest wounds and stumps; the carbolic spray will in all probability act as a preventive to this disgusting circumstance. The writer experienced an instance of their rapid formation or generation in India after the battle of Sultanpore. He amputated the leg of a native in consequence of a gun-shot wound. The stump was dressed with lint moistened with cold water, and secured for transport. On the second day after the operation, a considerable journey having been performed, on proceeding to dress it, the inside presented a living mass of maggots, which were removed, and the case progressed most favourably. By keeping lint saturated with turpentine on the outer dressings, no more maggots appeared. Creasote in solution, and common salt will expel them from a wound.

BLOODLESS OPERATION.

Professor Esmarch has lately introduced what is known as the "bloodless operation," whereby a surgeon can remove a limb or excise a joint below the main trunk of an artery, without losing a drop of blood, and with but little assistance from others—two great advantages in warfare. He describes it as follows:—"While the patient is being chloroformed, wrap the leg in waterproof varnished tissue paper, so that pus from the wound may not soil the bandage; then, with an elastic bandage made of india-rubber webbing, envelop the limb (if the leg, from the tips of the toes to above the knee), and, by equal compression, force the blood out of the vessels of the limb. Immediately above the knee, where the bandage ends, apply a piece of india-rubber tubing four or five times round the thigh, drawing it very tight and fastening the hooks which are at one end to the rings at the other. The india-rubber tubing compresses all the soft parts, including the arteries, so completely, that not a drop of blood can pass into the part which has been tied off. It has this advantage over all tourniquets, that you can apply it to any part of the limb, and need not give yourself any trouble about the position of the principal artery. Even in the most muscular and the fattest individuals, you can perfectly control the flow of blood in this simple way.

"The india-rubber bandage is now removed, and the varnished paper lying under it. The operation is then proceeded with, and having been completed, the india-rubber tubing is slowly removed. When you amputate you must loosen the tubing as soon as you have tied all the arteries that you can recognise with the naked eye, as it will be necessary to guard against secondary hæmorrhage before applying the dressings."

Since Professor Esmarch first introduced this method, he has altered his views as regards the removal of the compressing ring, which he now says should be loosened suddenly, not slowly.

Mr. Cripps, of St. Bartholomew's Hospital, London, has originated another process for "bloodless operations," which he considers an improvement on the elastic bandage. A short india-rubber tube is used, not only to prevent the blood from returning to the limb, but also for the purpose of removing it in the first place.

The two ends of an india-rubber tube, 21 inches in length, and about three-eighths of an inch thick, are bound together with a piece of twine, the whole forming an elastic ring 7 inches in diameter (fig. 109).

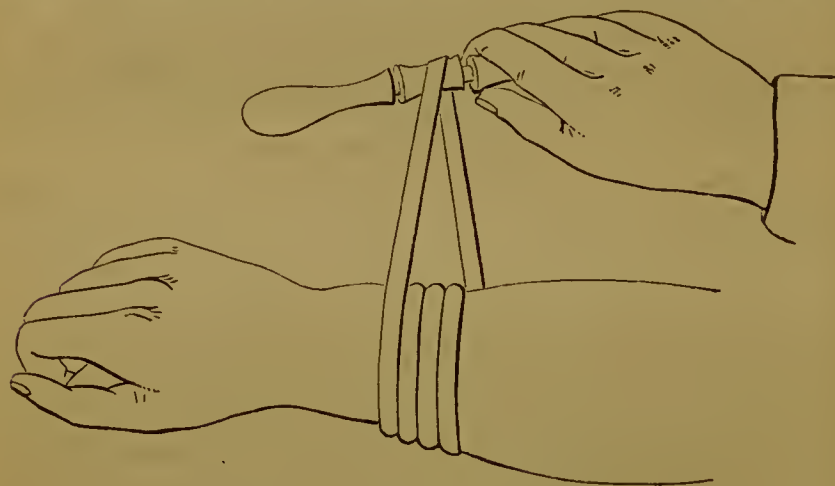


Fig. 109.

A grooved reel, revolving between a double handle, completes the necessary apparatus. To apply this to the arm, three or four complete turns of the elastic ring are wound tightly round the hand in such a manner as to include the fingers and thumb, care being taken that the turns lie even and do not cross one another. The reel is then put under the free portion of the ring connecting the upper and lower coil. The reel is passed round and round the limb in an upward direction; thus each coil is unwound from below as another is added above. The degree of tightness can be regulated with the greatest nicety by the distance the reel is drawn from the limb by the bandager. In applying it to the leg, it is necessary to place a pad in the popliteal space over which the coil should pass.

TO PREVENT HÆMORRHAGE AFTER THE BLOODLESS METHOD.

Without due precautions hæmorrhage is apt to occur after a bloodless operation. This, as a rule, may be prevented by irrigation of the wound with iced water, by securing everything that showed a lumen, including veins as well as arteries, by exposure of the wound, or by washing it with a strong solution of chloride of zinc.

Mr. Lister, instead of applying the elastic bandage, simply elevates the limb for some minutes, and then applies the constricting band. By this means the capillaries are not paralysed, and hæmorrhage is prevented.

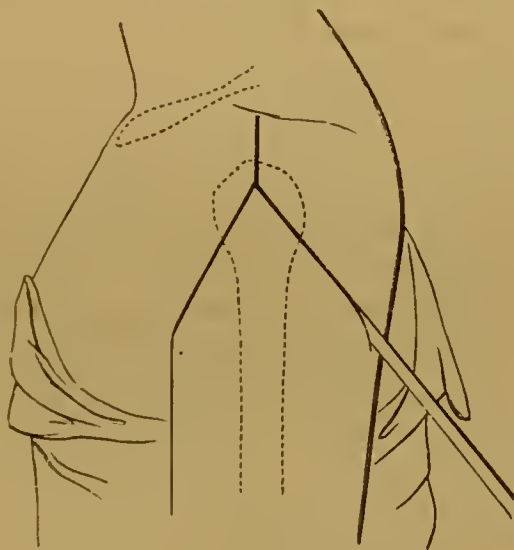


Fig. 110.

APPROVED METHODS OF AMPUTATING.

Amputation at the Shoulder-joint.—Hamilton, of the U.S. Army, recommends the following proceeding:—The arm lying nearly against the side of the body, with a large bistoury or a small dissecting-knife an incision is commenced at the middle point of the extremity of the acromion process, or two or three lines above this point (fig. 110), and carried perpendicularly downwards one inch and a half, the knife being made to cut deeply until it touches the head of the humerus; at this point the knife is carried obliquely, and rather abruptly, outwards and downwards to the centre of the lower margin

of the axilla on the under side of the arm ; in this second step of the incision, the tissues are divided down to the bone until the axillary margin is reached : from this point to the termination of the incision, only integuments are divided, so that we may avoid wounding the axillary artery. The knife is again introduced over the head of the humerus, at the point where the perpendicular incision became oblique, and it is carried down upon the inside of the arm in the same manner as we have described upon the outside.

One assistant pulling asunder the lips of the wound upon the top of the shoulder, while a second carries the elbow slightly across the body, and rotates the head of the humerus outwards, so as to expose the capsule and the long head of the biceps—the surgeon divides them with his knife, and at the same moment the head of the humerus springs from its socket.

The knife is then passed under the head of the bone from above, and as soon as the face of the instrument has fairly reached the surgical neck of the humerus, an assistant standing at the head of the patient pushes the thumbs of both hands into the wound above the knife, while the fingers remain in the axilla. He thus grasps and controls the axillary artery. The operation is completed by carrying the knife downwards close to the bone until the apex of the tegumentary wound in the axilla is reached, and then cutting almost directly outwards. Care must be taken not to sever the parts containing the artery until the knife has arrived at the lower margin of the axilla.

Amputation at the Shoulder-joint by Transfixion.—Lisfranc approved of this method, which Erichsen thus describes :—"A long narrow-bladed knife should be used. One assistant must have charge of the limb ; another should raise the flap ; and a third must follow the knife as it cuts behind the humerus, and grasp the posterior flap with the axillary artery, so as to prevent hæmorrhage from this vessel. An assistant holding the arm away from the body, so as to relax the deltoid somewhat, the knife, instead of being entered by a puncture, should make a small cross-cut, about an inch in extent, at the point at which transfixion is to be practised, so as to prevent that jagging of the integuments by the heel of the instrument which would otherwise occur. If the operation be on the right side, the surgeon stands before the patient, and the point of the knife should be entered about an inch in front of the acromion (fig. 111), and being carried directly across the joint and capsule, should pass out at the posterior border of the axilla. If on the left side, the surgeon stands behind, and the point of the knife must be entered well behind the spine of the scapula, at the posterior border of the axilla, carried across the anterior aspect of the joint, and brought out to the inner side of the coracoid process. In either case, the large flap containing the deltoid muscle must then be cut with a sweep of the knife downwards, and, as soon as made, raised by another assistant. The heel of the knife is now to be laid on the head of the bone, the capsule of joint cut

across, and the attachments of the muscles to the tuberosities divided. After the head of the bone has been turned out of the glenoid cavity, the knife must be passed behind it and carried down for a distance of about 3 inches close to the bone at its inner side. The surgeon then cuts across the soft parts, so as to form the posterior flap. In doing this, the assistant to whom this part is entrusted must follow the knife with his hands, grasping firmly the whole thickness of the posterior flap, so as to compress the axillary artery, and thus prevent the occurrence of hæmorrhage.

Sir W. Fergusson recommends that a bistoury be used for these operations, instead of the more imposing-looking amputating knife; but with

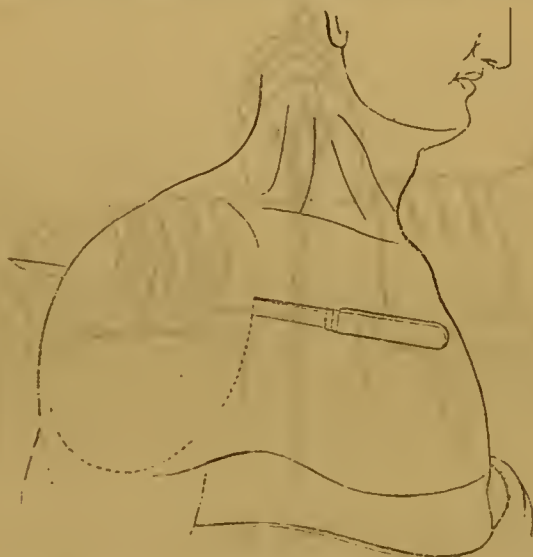


Fig. 111

such an instrument the first flap on the left shoulder would be made by cutting from the skin towards the joint.

Amputation of the Arm (Circular).—"The arm being held out, and an assistant drawing up the skin, one circular incision is made through the integuments, which are forcibly retracted and detached from the deeper structures by a few touches of the point of the knife, and doubled back to the extent of an inch and three-quarters, or more, according to the thickness of the arm, another is made down to the bone (fig. 112). These incisions should be made with slight divergences so as to cut the skin and muscles rather longer in front and behind than at the sides."

Amputation above the Elbow.—"The patient being seated, or laid on a table, with the elbow separated from the side, the humeral artery being secured by pressure, the arm should be transfixed 3 inches above the external condyle with a knife about 7 inches in length, which should be carried obliquely downwards and forwards, so as to make from the inner surface a semi-lunar flap between 2 and 3 inches long: this should then be raised, when the soft parts on the opposite side should be divided in the same manner to a similar extent; the two flaps should now be drawn upwards, and the knife then carried round the bone, which should next be sawn through, and so the removal is completed. The flaps should then be

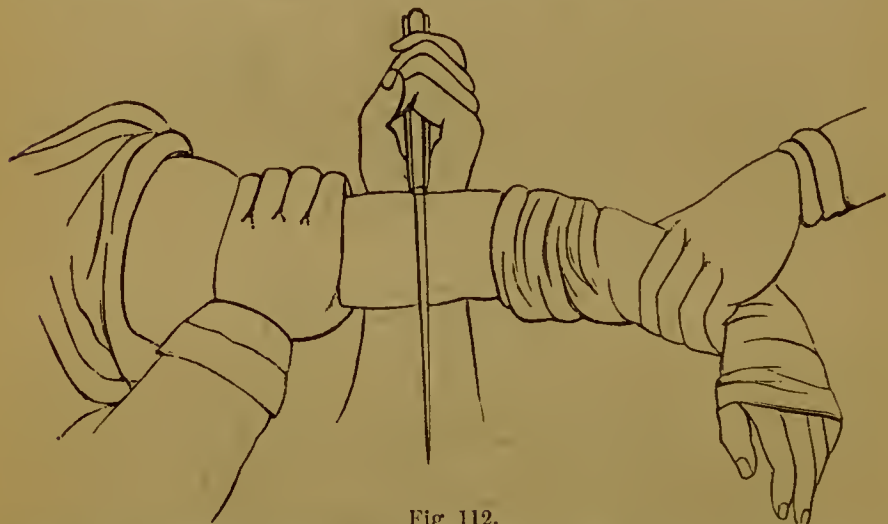


Fig 112.

brought into contact and kept in apposition with four or five stitches. Fig. 113 is intended to show the position of the knife after transfixion, and the dotted line the shape of the anterior or inner flap. The arm may either be straight, as exhibited in the figure, or slightly bent at the elbow, according to circumstances. The operation should be done in the lower third of the arm, if circumstances will permit; but the same instructions will answer for any part of its extent between the condyles of the humerus and its neck."*

Amputation through the elbow-joint can be performed by the circular method or by flaps. If by the circular, Hamilton recommends "that the incision should commence at least 3 inches below the joint. The integuments being retracted, the head of the radius should be sought, and the

* "Practical Surgery," by Sir William Fergusson, p. 296.

external lateral ligament severed; after which, having divided all the muscles, including the tendon of the biceps and the brachialis anticus, the coronoid process of the ulna will be easily made out; the anterior ligament and capsule may now be severed more completely, then the external lateral ligament. By moderate pressure upon the forearm the joint will now open sufficiently to admit the saw, if it is thought desirable to sever the olecranon process. It is a matter of indifference, perhaps, whether we dissect out the olecranon by cutting the triceps from behind, or divide it with the saw applied as we have directed."

Flap Method.—"This is performed by passing the knife through the

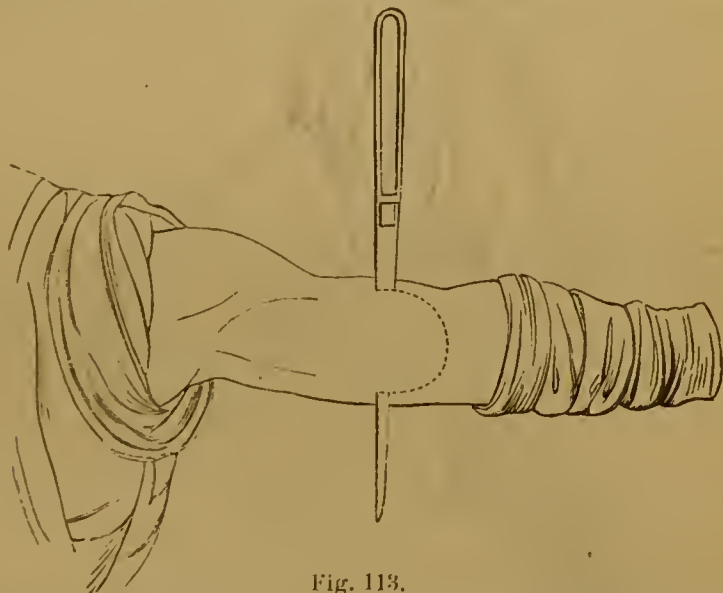


Fig. 113.

muscles in front of the joint, and cutting upwards and forwards, so as to make a flap from the forearm. Then the operator makes a transverse incision from behind the joint. He next cuts through the external lateral ligament, and enters the joint between the head of the radius and external condyle, then divides the internal lateral ligament, and, lastly, saws through the olecranon, the apex of which, attached to the triceps, may be left in the stump, or may be afterwards dissected out."

Amputation of the Forearm.—In performing this operation, as long a stump should be left as possible, so as to give the patient more power over any artificial limb that may be fitted to it. "The flaps should be about a couple of inches in length, and well rounded, the hand being placed in a

mid-state between pronation and supination. The dorsal flap is best made by cutting from without inwards; the line of incision commencing just at the palmar aspect of the under part of the ulna, being carried forward for a little distance parallel to this bone, and then across the back of the arm in a slightly curved manner, until it reaches the palmar aspect of the radius; it must then pass along this until it reaches a point opposite to that at which it commenced, and the flap thus made must be dissected



Fig. 114.

back. The palmar flap is next made by transfixion. As soon as it is cut, the bones are cleared by a couple of sweeps of the knife, and the interosseous membrane is divided; they are then sawn together. The vessels are cut long at the end and on each side of the palmar flap."

Sir W. Fergusson recommends in performing this operation, "to have the elbow slightly bent, and the hand placed in a state of pronation (fig. 114). A blade about 6 inches long should be passed from one side to the other, behind (or above) the bones; it should then be carried downwards, so as

to come through the tendons and skin about an inch and a half lower down; the flap thus formed being raised, the knife should next be passed across close in front of the bones, and carried obliquely downwards, when a second flap, similar in size and shape to that already made, will be formed: both of these should now be drawn slightly upwards, and after all the textures close upon the bones have been divided, the saw should be applied close to the roots of the flaps, and the part separated."

Amputation at the Wrist (Flaps).—"A semi-lunar incision is made across the back of the wrist, its extremities being at the styloid processes, and its centre reaching down as far as the second row of carpal bones. This flap being dissected up, the joint opened behind, and the lateral ligaments cut



Fig. 115.

through, the knife, being placed between the carpus and bones of forearm, is made to cut out a flap from the anterior surface of the palm (fig. 115). The pisiform bone often causes, by its projection into the palm, a difficulty in cutting the anterior flap; if not dexterously avoided by the edge of the knife, it had better be taken at the joint with the soft parts of the flap, and afterwards dissected. The nerves and tendons must be shortened, the styloid processes removed, and the skin brought together by sutures."

Amputation at the Wrist by External Flap.—Commencing just below the level of the articulation, while the hand is pronated, the surgeon makes a convex incision, beginning at the junction of the outer and middle thirds of the arm, reaching at its summit the middle of the dorsal surface of the first metacarpal, and terminating in front, just below the palmar surface

of the joint, again at the junction of the outer and middle thirds of the breadth of the arm. This flap being raised, the wrist is disarticulated, beginning at the radial side. A circular incision finishes the cutting of the skin.*

Amputation of one or more Metacarpal Bones.—No rules can well be given for incision or flaps; they must just be obtained where and how they can best be got. A single dorsal incision over the bone will allow it to be dissected out of the hand.

Amputation of Index or Little Finger.—"The knife should be applied over the back and middle of the metacarpal bone, and carried downwards along the side and under-surface of the joint, and up again to where it was first entered, as represented by dark lines in fig. 116. After this the soft parts near the bone must be divided, and then the forceps may be used in such a manner as to cut the bone obliquely, so that there shall be no angular projection towards the skin."



Fig. 116.

Amputation of the metacarpal bone of the thumb may be performed in many different ways. The method recommended by Erichsen is as follows:—"The mode of proceeding must vary according to the side operated upon. When the left thumb requires amputation, the point of a long narrow bistoury should be introduced well on the palmar aspect of the carpo-metacarpal articulation, carried over this, which it opens, and the dorsum of the hand as far as the web of the index finger; the point of the knife should then be pushed downwards through the ball of the thumb, transfixing this, and issuing where the incision commenced. It is next made to cut outwards, keeping

close to the metacarpal bone, which is readily twisted out, the remaining attachment being separated by a few touches of the knife. In amputating the right thumb, it will be necessary for the surgeon, if he adopt the method just described, either to use his left hand, or to cross his hands in an awkward manner. In order to avoid doing this, he may reverse the steps of the operation with advantage; first transfixing the ball, and making the anterior flap, then cutting over the dorsum, opening the joint, and turning out the bone."

"The metacarpal bone of the thumb may be removed through an incision on its radial margin, where the surgeon may avoid cutting either the extensor or flexor tendons. The distal extremity should first be detached from its connections, when the bone can be used as a lever whilst separating

* "Manual of the Operations of Surgery," by J. Bell. F.R.C.S.E. p. 54.

it from the other parts. The radial artery will be endangered whilst cutting some of the fibres which bind the bone to the os trapezium."

Amputation of a whole Finger.—"If the third or fourth digits require amputation, it should be performed as follows:—An assistant holds the hand, separating the fingers at each side of the one to be removed. The surgeon, holding the finger to be removed, enters the point of a long straight bistoury exactly above the metacarpo-phalangeal joint, and cuts from the prominence of the knuckle right into the angle of the web, then turning inwards there, cuts obliquely into the palm to a point nearly opposite the one at which he set out. He then repeats this incision on the other side, makes tense the ligaments, first at one side and then at the other, by drawing the finger to the opposite side, and cuts them. The tendons being cut, the finger is detached."

Amputation through the Second Phalanx.—"If the distal phalanx be so much crushed that a flap cannot be obtained, two short semi-lunar lateral flaps may be dissected from the sides of the second phalanx, which may then be divided by the bone-pliers at the spot required."

Amputation of a Distal Phalanx.—"There is no choice as to a flap, the nail preventing an anterior one; so a flap long enough to fold over must be cut from the pulp of the finger in either of two ways. 1. Holding the fragment to be removed in the left hand, and bending the joint, the surgeon makes a transverse cut across the back of the finger, right into and through the joint, cutting a long palmar flap from within outwards as he withdraws the knife. 2. Making the long flap by transfixion, it may be held back by an assistant, and the joint cut into."

Amputation at the Hip-joint.—Numerous methods have been described for performing this operation. The following is *Lisfranc's double lateral flap* (fig. 117):—



Fig. 117.

"The patient must be laid upon his back with the tuberosities of the ischia projecting slightly beyond the edge of the bed, and the limb held in a position between abduction and adduction. Then having determined, by the anatomical rules laid down, the anterior and external side of the articulation, the operator, holding perpendicularly a long double-edged knife, introduces it at this point, with its lower edge looking downwards towards the great trochanter. As the point of the knife enters, it should be carried around the head of the femur on its outer side, whilst its handle is inclined upwards and outwards, and pushed steadily on in this direction, so that it perforates the integuments a few lines below the tuberosity of the

ischium. While this is being done, an assistant grasps the tissues over the trochanter, and carries them outwards, in order to assist in the formation of the external flap, and the knife is carried downwards and outwards with a slightly sawing motion, around the great trochanter and along the femur, cutting out the flap from 3 to 4 inches in length. The first flap being thus made, the operator, grasping the tissues on the inside of the thigh and carrying them inwards, introduces the knife below the head of the femur, and on the inner side of its neck, holding it in a perpendicular position. As it enters, the point of the knife should pass round the neck of the femur, and come out at the lower angle of the wound already made, without coming in contact with the bones of the pelvis; it is then carried downwards along the femur, and avoiding the lesser trochanter, so as to make an internal flap of the same length as the external. The flaps being drawn aside by the assistants, and the arteries tied, the surgeon grasps the femur with his left hand, and holding the knife perpendicularly on the inner side of the head of the bone, cuts the capsular ligament, without attempting to penetrate the articulation. The joint being opened, the disarticulation is concluded by cutting the fibrous and muscular tissues which remain." *.

Guthrie recommends the oval method, and describes it thus:—"The patient is to be laid on a low table, or other convenient thing, in a horizontal position; an assistant, standing behind and leaning over, compresses the external iliac artery becoming femoral, as it passes over the edge of the pubis. The surgeon, standing on the inside, commences his first incision, some 3 or 4 inches directly below the anterior spinous process of the ilium, carries across the thigh through the integuments, inwards and backwards, in an oblique direction, at an equal distance from the tuberosity of the ischium to nearly opposite the spot where the incision commenced; the end of this incision is then to be carried upwards, with a gentle curve behind the trochanter, until it meets with the commencement of the first; the second incision being rather less than one-third the length of the first. The integuments, including the fascia, being retracted, the three gluteal muscles are to be cut through to the bone. The knife being then placed close to the retracted integuments, should be made to cut through everything on the anterior part and inside of the thigh. The femoral or other large artery should then be drawn out by a tenaculum or spring forceps, and tied. The capsular ligament being well opened, and the ligamentum teres divided, the knife should be passed behind the head of the bone thus dislocated, and made to cut its way out, care being taken not to have too large a quantity of muscle on the under part, or the integuments will not cover the wound, under which circumstance a sufficient portion of muscular fibre must be cut away. The obturator, gluteal, and ischiatic arteries are not to be feared, being each readily compressæd by a finger until they can

* Hamilton's "Military Surgery," p. 477.

be duly secured. The capsular ligament, and as much of the ligamentous edge of the acetabulum as can be readily cut off, should be removed. The nerves, if long, are to be cut short. The wound is then to be carefully cleansed, and brought together by three or more soft leaden sutures in a line from the spine of the ilium towards the tuberosity of the ischium. This mode of proceeding is more certain of making good flaps where integuments are scarce. Where the integument will admit of the anterior flap being made by the sharp-pointed puncturing knife dividing the parts after it has been passed across from without inwards, there is no objection to this proceeding, and some prefer it." The outline of incision in Mr. Guthrie's method is represented in fig. 118.



Fig. 118.

Sir William Fergusson recommends the following proceeding:—"The table should be stout, of a convenient height, not so broad as to prevent the surgeon and assistants being in close contact with the patient, and a folded blanket, with a couple of pillows, should be on its upper surface. The patient's breech should be brought close to the margin of the table, and the sound limb should be fastened to one of its legs. An assistant should stand immediately behind the surgeon, whose chief duty will be to raise the first flap and compress the femoral artery; another should stand opposite to hold the pelvis steady, and assist in keeping the patient's body from slipping. A third may also be useful at the shoulders to aid in this, as, from so much of the body being beyond the table, and perhaps also from the mode of operating, there is a chance of the pelvis falling over the

margin; a fourth should have the limb entrusted to his care, and he, with the other who has charge of the artery, should clearly understand the intended movements of the surgeon; and the immediate and satisfactory accomplishment of the operation depends much on the simultaneous movements of the whole three.

“The surgeon, standing on the outside of the limb, should insert the point of a long knife about midway between the anterior superior spinous process of the ilium and trochanter major, keeping it rather nearer the former than the latter; he should then run it across the front of the neck of the bone, and put it through the skin on the opposite side (fig. 119), about 2 or 3 inches from the anus; next he should cut downwards and forwards, so as to make a flap from the anterior of the thigh, about 5 or 6 inches

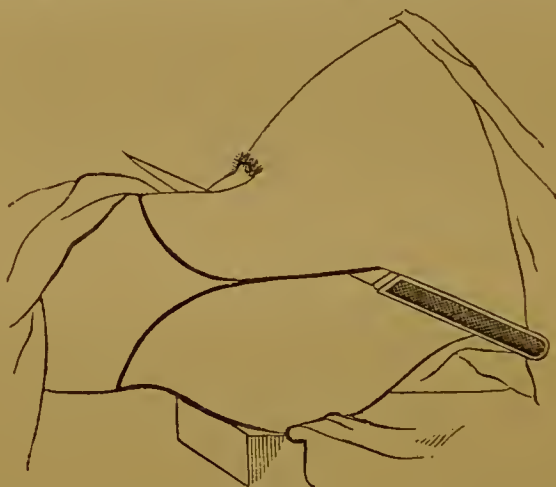


Fig. 119.

in length. When the blade is entered, the limb should be held up, and even slightly bent at the joint; the instrument will then pass along more readily than if all the textures were thrown on the stretch; moreover, there is greater certainty of passing it behind the main vessels, and even dividing some of the fibres, if not the whole of the iliacus internus and psoas muscles. As the knife is carried downwards, the assistant, who stands nearer the patient's trunk than does the operator, should slip his fingers into the wound and carry them across to grasp the femoral artery between them and the thumb; this he may do from the inside or outside at will, and with the right or left hand, as may be most convenient, the same grasp enabling him to raise the flap as soon as it is completed. The flap being raised, the

point of the knife should then be struck against the head of the bone, so as to divide the anterior part of the capsular ligament and any textures in this situation which may not have been included in the flap. To facilitate this part of the operation, the knee should be forcibly depressed by the assistant who holds it; the head of the bone will thus be caused to start out of its socket, and if the round ligament is not ruptured by the force, a slight touch with the edge of the knife will cause it to give way. At this period, depression being no longer required, the assistant should bring the head of the femur a little forward to allow the knife to be slipped over and behind it; and when it is in this position, it should then be carried downwards and backwards, so as to form a flap somewhat longer than that in front, the last cut in the skin completing the separation of the limb.

"Delpech, Larrey, and others recommended ligation of the femoral artery as a preliminary step; but it seems unnecessary, and the proceeding has been rarely resorted to."*

Amputation of the thigh may be performed by the circular method, by the lateral flap operation, by the antero-posterior flap operation, or flaps may be taken from any opposite aspects, or Teale's method may be adopted.

The operation may be performed immediately above the knee, in the middle of the limb, or in its upper third. In the middle and upper thirds of the thigh, the antero-posterior flaps leave the best results, and give the best covering to the bone; but amputation above the knee is best done by lateral flaps.

Antero-posterior Flap Operation.—"In ordinary cases the anterior flap may first be made, and posterior one subsequently fashioned by transfixion. If, however, the patient is very much emaciated, it is difficult to get a good cushion from the anterior part of the thigh in this way; and it is consequently preferable to follow the plan recommended by Mr. Luke, of making the posterior flap first by transfixion, and the anterior one afterwards by cutting from without inwards. In some instances in which the tissues at the posterior part of the thigh are much diseased or injured, whilst those on the anterior aspect of the limb are sound, a very good stump may be fashioned by cutting a long square anterior flap by transfixion, and then cutting at one stroke of the knife through the soft parts at the posterior aspect of the limb, in a somewhat oblique direction, from below upward.

"If the patient be excessively muscular, and the amputation be a primary one, it is better to make skin-flaps with a circular incision through the subjacent soft parts."†

Amputation of the Thigh, similar to that by Vermeil's Operation.—"The surgeon, standing on the outside of the limb, should grasp the soft parts on the outer side of the thigh between the finger and thumb, and having drawn

* "Practical Surgery," by Sir W. Fergusson, p. 448.

† "Science and Art of Surgery," by Erichsen, vol. i. p. 55.

them, as it were, from the side of the bone, should pass the knife from before backwards, or rather from above downwards, as represented in fig. 120, and then cut downwards and outwards, so as to form a flap, the extremity of which is pointed out by the dotted line on the outer side. Next, the knife should a second time be introduced in front, and carried backwards or downwards in the line with its original course, but on the opposite side of the bone, when, by cutting again downwards and towards the surface, the inner flap is formed; both of them should then be drawn upwards with consider-

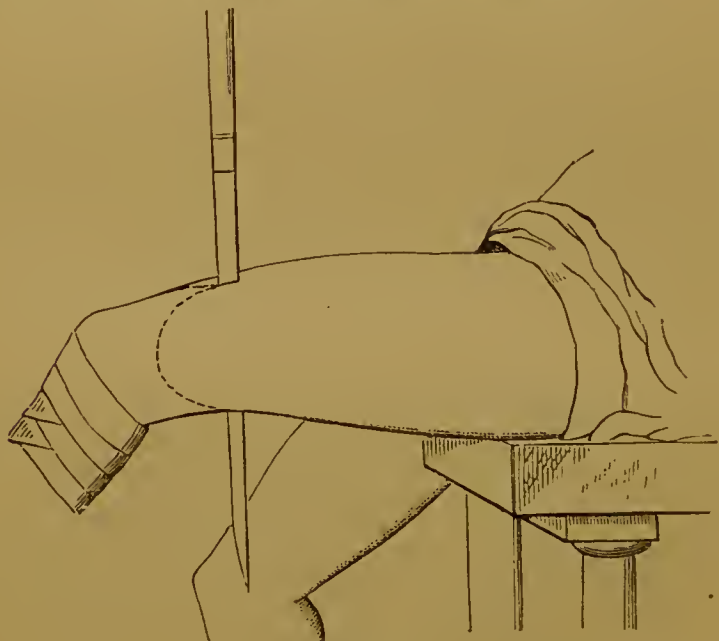


Fig. 120.

able force by the hands of an assistant, and an incision made round the bone, an inch or more higher than the place of transfixion; the saw should then be applied in the course of this last cut, and separation completed by division of the bone. In transfixing, the point of the knife should be thrust directly down to the femur, with which it should be kept in close contact as it is carried round to the opposite surface. And this process will be greatly facilitated by grasping the limb as directed."

Amputation through the knee-joint may be performed with a long posterior and short anterior, or with a long anterior and short posterior flap.

The operation with the long posterior and short anterior flap may be readily performed in the following way:—"An incision is made directly across the knee-joint, above the centre of the patella. The skin flap thus formed is dissected back, and, the joint being opened above the patella, and the ligaments divided by a few touches of the knife, a long posterior flap is cut from the upper part of the calf of the leg, by passing the knife behind the tibia, and carrying it downwards for a suitable distance.

The operation by means of a long anterior and a short posterior flap is thus performed: "A long square flap, rounded at the corners, is made by dissecting up the integuments and the patella from the front of the joint. The articulation is thus opened; the ligaments are then divided, and a short posterior flap formed by cutting from within outwards.

"The management of the patella is an important question. Erichsen thinks it is decidedly better to leave than to remove this bone; and to prevent it being drawn up on anterior part of the thigh, the flap should be turned up, and the tendinous insertion of the quadriceps divided. The cartilaginous surface of the femur in these amputations may be sawn off."

Amputation through the Condyles of the Femur (Syme's).—"With an ordinary amputating knife, make a lunated incision from one condyle to the other across the front of the joint, on a level with the middle of the patella, divide the tissues down to the bones, and then draw the flap upwards, then cut the quadriceps extensor immediately above the patella. The point of the blade should then be pushed in at one end of the wound, thrust behind the femur, and made to appear at the other end; it should then be carried downwards, so as to make a flap from the calf of the leg, about 6 or 8 inches in length, in proportion to the thickness of the limb; the flap should then be slightly retracted, and the knife carried round the bone a little above the condyles, to clear a way for the saw, which should be applied so as to leave the section as horizontal as possible."

Carden's Amputation at the Condyles of the Femur.—"The operator standing on the right side of the limb, seizes it between his left forefinger and thumb at the spot selected for the base of the flap, and enters the point of the knife close to his finger, bringing it round through the skin and fat below the patella to the spot pressed by his thumb; then turning the edge downwards at a right angle with the line of the limb, he passes it through the spot where it first entered, cutting outwards through everything behind the bone. The flap is then reflected, and the remainder of the soft parts divided straight down to the bone; the muscles are then slightly cleared upwards, and the saw is applied."

Fig. 121 represents the outline of the incision, and fig. 122 the stump.

Mr. Carden lays great stress on the following points:—"Whilst tying the popliteal artery in this situation, there is a tendency to secondary hæmorrhage from the vein, in consequence of its close proximity to the artery.

This occurred in two cases, and on re-opening of the stumps the closure of the vein was found to be prevented by the stroke of the artery. The vessels should be gently separated for an inch upwards. The dressing may be of the lightest and simplest kind, and it is of the greatest importance that they should be loosened and the stump examined early."

In performing this amputation, I have observed great liability to retraction of the soft parts at the back of the stump; I therefore recommend that in making the posterior cut, the knife should have an inclination forwards, instead of at a right angle with the line of the limb.

Amputation of the Leg, double flap upper fourth.—"A stout bistoury

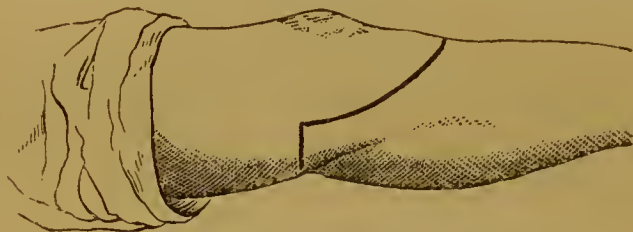


Fig. 121.

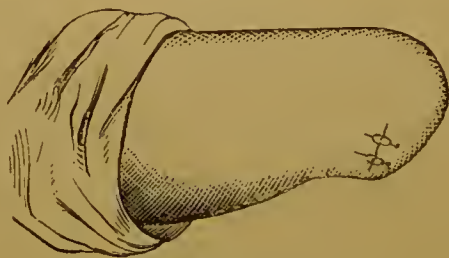


Fig. 122.

with a blade 4 or 5 inches long, and a broad saw, are the only cutting instruments required. The flaps are made of integuments only, by cutting from the surface without transfixion. The point of the knife is entered at the side, about 2 inches below the tibial tubercle, and carried across the front of the leg, describing an anterior curved flap rather longer than, and of the exact width of, the half diameter of the limb. This is dissected up close to the bones and deep fascia. A flap exactly similar is then made on the posterior aspect, and the integuments composing it are raised from the muscles. The latter, with the large vessels and nerves, are then divided transversely, direct to the bones. The bones are then equally sawn across."

Oval Amputation through the Calf.—"An oval incision is made in the

direction shown in fig. 123, through skin and fat; these are thoroughly drawn back; the incision is carried upwards obliquely through the gastrocnemius to the bones, so as to make a posterior flap; this being well pulled up, the remaining soft parts around and between the bones are divided;

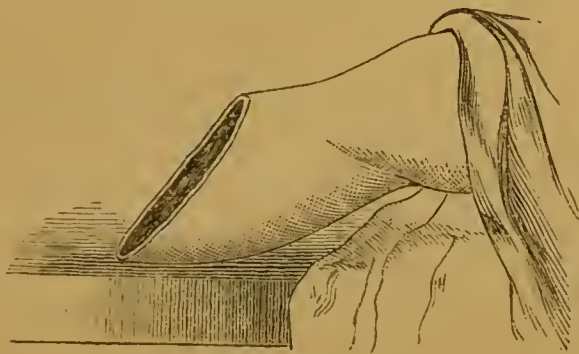


Fig. 123

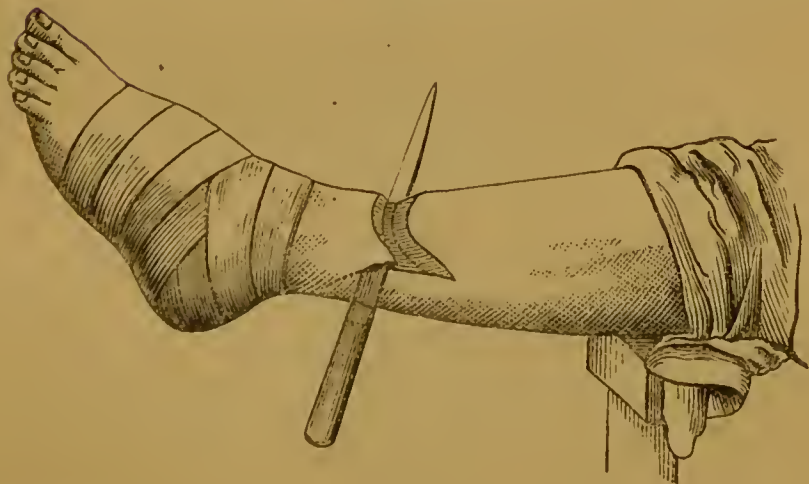


Fig. 124.

lastly, the bones are sawn through. The integuments are brought together in a transverse line. The objection to this method is, that from retraction of the muscles in the posterior flap, the front edge of the cut tibia may be left bare, and become necrosed, or give rise to a tender stump."

Amputation of the Leg by single flap Operation, as practised by Sir W. Fergusson.—"The heel of the instrument should be laid on the side of the leg farthest from the surgeon, and the blade should then be drawn across the front, cutting a semi-lunar flap of skin, until its point comes opposite to where the edge was first laid on; without raising the instrument, transfixion should next be made behind the bones (fig. 124), and the rest of the proceedings conducted as in other instances."

Circular Method.—The leg being placed horizontally, one assistant supporting it at the ankle, and another holding it at the knee, and drawing up the skin, the surgeon makes a circular incision through the skin, 4 inches below the tuberosity of the tibia. The integuments are next to be dissected up for 2 inches, and turned back; and the muscles divided down to the bone by a second circular incision. Then a slender catlin is passed between the bones to divide the interosseous ligament and muscles, and both bones are sawn through together, the flesh being protected by a retractor, which



Fig. 125.

should have three tails. The spine of the tibia may be removed with a fine saw or bone nippers. The integuments should be put together transversely.

Disarticulation of the Foot at the Ankle-joint (Syme's Amputation).—The foot being held at a right angle to the leg, the point of the knife is introduced immediately below the malleolar projection of the fibula, rather nearer its posterior than anterior edge, and then carried across the bone to the inner side of the ankle, where it terminates at the point *exactly opposite* its commencement.

The extremities of the incision thus formed are then joined by another passing in front of the joint (fig. 125). The operator next proceeds to detach the flap from the bone, and for this purpose, having placed the fingers of his left hand over the prominence of the os calcis, and inserted the point of his thumb between the edges of the plantar incision, guides the knife between the bone and the nail of the thumb, taking great care to cut parallel with the bone, and to avoid scoring or laceration of the integuments. He then

opens the joint in front, carries the knife outwards and downwards on each side of the astragalus, so as to divide the lateral ligaments, and thus completes the disarticulation. Lastly, the knife is carried round the extremities of the tibia and fibula, so as to afford room for applying the saw by means of which the articular projections are removed, together with a thin connecting slice of bone covered by cartilage. The vessels being then tied, and the edges of the wound stitched together, a piece of wet lint is applied lightly over the stump, without any bandage, so as to avoid the risk of undue pressure in the event of the cavity becoming distended with blood, which would be apt to occasion sloughing of the stump.*

Amputation through the Tarsus (Chopart's Operation).—"In the first place, the articulation of the cuboid with the os calcis (which lies about midway between the external malleolus and the tuberosity of the fifth metatarsal bone), and that of the navicular with the astragalus (which will be found just behind the prominence of the navicular bone in front of the inner ankle), must be sought for, and a semi-lunar incision be made, across the dorsum, from one to the other. The flap of the skin being turned, the internal and dorsal ligaments that connect the navicular to the astragalus are to be divided with the point of the bistoury, recollecting the convex shape of the head of the latter bone. The ligaments connecting the os calcis and cuboid are next divided; and, lastly, a flap is to be procured from the sole of the foot."

Amputation of all the Metatarsal Bones (Hey's Operation, as described by himself).—"I made a mark across the upper part of the foot, to point out as exactly as I could the place where the metatarsal bones were joined to those of the tarsus. About half an inch from this mark, nearer the toes, I made a transverse incision through the integuments and muscles covering the metatarsal bones. From each extremity of this wound I made an incision (along the inner and outer side of the foot) to the toes. I removed all the toes at their junction with the metatarsal bones, and then separated the integuments and muscles forming the sole of the foot from the inferior part of the metatarsal bones, keeping the edge of my scalpel as near the bones as I could, that I might both expedite the operation and preserve as much muscular flesh in the flap as possible. I then separated with the scalpel the four smaller metatarsal bones at their junction with the tarsus, which was easily effected, as the joints lie in a straight line across the foot. The projecting part of the first cuneiform bone which supports the great toe I was obliged to divide with a saw."

To avoid the difficulties of disarticulation, Skey recommends cutting off the head of the second metatarsal with a pair of pliers. Baudens, Guérin, and others, approve of sawing all the bones across in the line desired.†

* "Principles of Surgery," Syme, p. 166.

† Bell's "Manual of Operative Surgery," p. 70.

Removal of Metatarsal Bone of Great Toe.—"The point of a strong and broad bistoury should be entered on the dorsum of the foot over the interspace between the first and second metatarsal bones, as far back as possible; it should then be carried forwards upon the ball of the great toe, to a point opposite to the web between the toes, and thence made to sink into the sole of the foot in a line parallel with the outer margin of the bone; the flap thus formed should be dissected back, its plantar aspect being kept as thick and fleshy as possible. The surgeon next passes the knife between the first and second metatarsal bones, and cuts directly forwards through the centre of the angle between the great and the second toes. In doing this, care must be taken that the edge of the knife is not directed too much towards the metatarsal bone of the great toe, lest it hitch against one of the sesamoid bones. The surgeon next seizes the extremity of the toe, and, pressing it well inwards, passes the point of the bistoury deeply into the angle of the wound, where, by the division of some tendinous and ligamentous fibres that constitute the key of the joint, he opens the articulation, and detaches the bone by lightly touching its ligamentous attachments.

"When the bone is to be partially removed, the operation must be performed in the same way; the incisions, however, not being carried so far backwards."*

Removal of Metatarsal Bone of Little Toe.—"This is best done by entering the point of the knife just behind the tubercle of the bone, carrying it forwards and inwards in the line of its articulation with the cuboid, to the centre of the fourth digital interspace, and thence forwards to the web of the toe; the knife is next carried round the plantar surface of this, the incision being continued obliquely into that which has been made on the dorsum of the foot. The small flap thus formed is well dissected down, the knife passed round the under surface of the bone, and the joint opened by the toe being forcibly drawn outwards, and its ligamentous connection lightly divided."†

Amputation of Distal Phalanx of Great Toe.—When possible, a long flap should be made from the plantar surface, by laying the edge of the knife over the dorsal aspect of the joint, cutting through it, and turning the edge of the knife round close to the bone, so as to cut out a long flap from the ball of the toe.

Amputation of a single lesser Toe: Second, Third, or Fourth.—"This operation is exactly on the same principle as that described for amputation of a whole finger, but it should be remembered that the metatarso-phalangeal joint is more deeply situated in the soft parts than is the metacarpophalangeal; and thus the commencement of the elliptical incision which is to surround the base of the toe must be proportionally higher up. On the other hand, as it is very important to avoid as much as possible any cicatrix

* Erichsen's "Science and Art of Surgery," vol. i. p. 45. † *Ibid.* p. 48.

in the sole of the foot, the plantar end of the incision need not be carried to a point exactly opposite the one from which it set out, but it will be sufficient if it reaches the groove between the toe and sole."

Teale's Operation (Amputation).—This plan of operation Mr. Teale introduced "to procure a more useful stump, and in the hope of somewhat diminishing the mortality of the operation. It is proposed to amputate by a long and a short rectangular flap, the long flap folding over the end of the bone being formed of parts generally devoid of large blood-vessels and nerves, whilst those important structures are contained in the short flap. The size of the long flap is determined by the circumference of the limb at the place of amputation, its length and its breadth being each equal to half the circumference. The long flap is therefore a perfect square (fig. 126), and is long

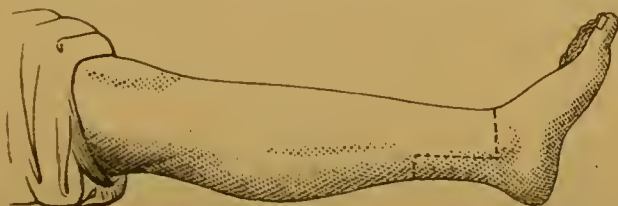


Fig. 126.



Fig. 127.

enough to fall easily over the end of the bone. In selecting the structures for its formation, such parts must be taken as do not contain the larger blood-vessels and nerves. A flap so formed will be for the most part anterior in position as far as regards the general aspect of the body, but superior when the patient is in the recumbent position, as during the after-treatment. The short flap, containing the chief vessels and nerves, is in length one-fourth of the other. The flaps being formed, the bone sawn, and arteries tied, the long flap is folded over the end of the bone; each of its free angles is then fixed by sutures to the corresponding free angle of the short flap. One or two more sutures complete the transverse line of union of the flaps. At each side the short flap is united to the corresponding portion of the long one by a point of suture, and one suture more unites the reflected portion of the long flap to its unreflected portion. Thus, the trans-




verse line of union is bounded at each end by a short lateral line at right angles to it (fig. 127).

Pirogoff's Amputation.—"The operation is performed in the following way:—An incision is carried across the sole of the foot from one malleolus to the other. This incision must not be made directly transverse to the foot, but should incline forwards obliquely, so that the centre of the incision in the sole may be at least an inch in front of a line drawn across from the tip of one malleolus to the other. The flap thus traced is dissected for about two lines. Disarticulation of the astragalus is then effected in the usual way by an incision across the front of the foot. A narrow amputating or a butcher's saw is now applied to the upper and back part of the os calcis behind the astragalus, and the bone is cut obliquely downwards and well forwards; the malleoli are then removed, and a thin slice of the tibia, with the articular cartilage, taken off. The opposed osseous surfaces must then be accurately adjusted, the movable flap well supported by a broad strip of plaster, and the limb laid on the outer side, with the knee placed so as to take off the tension of the tendo-Achillis."

This amputation has been objected to by many on account of the liability to recurrence of disease in the portion of the os calcis. It has certainly not been successful with army surgeons. Mr. Bryant looks upon the operation "as a very excellent one; it ought always to be preferred to Syme's when the os calcis is sound. Should the bone be found to be bad at the time of the operation, it must be taken away, the operation being made into a Syme's; but when the bone is good, it appears to be a grave error to take away what makes so good a point of support to the body."

Sub-periosteal Amputation.—To prevent attenuation of the end of the bone or necrosis, Langenbeck has proposed that its divided surface should be covered with a long flap of periosteum formed in the course of the amputation. Dr. R. Schneider holds that Langenbeck's proceeding does not always lead to such good results, and that the single flap of periosteum may slough. He recommends two short flaps of periosteum, each flap being carefully retained in connection with the superjacent muscular and other soft parts.

EXCISION.

Excision of the Head of the Humerus.—This operation may be performed in several different ways: they consist of a single vertical incision, and its modifications of  and  shaped ones; also the flap operation of  shape. Larrey recommended the single long incision, extending in a line from the acromion, through the fibres of the deltoid, for about 4 or 5 inches. This operation is thus described:—"The patient lies on the side opposite

to the affected or injured limb. The surgeon then enters the knife a little to the outside of the coracoid process, and carries it downwards and outwards for about 5 inches, cutting down to the bone. He then cuts across the capsule any adhesions that may exist, and the attachments of the muscles inserted into the tubercles of the humerus. The assistant, who has charge of the limb, facilitates this part of the operation by drawing it well across the chest, and pushing the head of the bone backwards and tilting it outwards, so as to cause it to project. The surgeon, carefully clearing it all round, has the soft parts well retracted, and then, taking the limb in his own hands, pushes the head of the bone out of the wound, so as to admit of the easy application of the saw by which it is removed."

Mr. Hamilton remarks on this subject:—"In gun-shot or other comminuted fractures of the head of the humerus, demanding ex-section, the surgeon will find it necessary, in general, to make for himself a larger opening than the single longitudinal incision will furnish. It will be necessary, then, to make an oval or **V**-shaped incision, so as to form a flap, having its base upwards."

Guthrie considers that in doing this operation, in cases of some standing, he prefers a short crescentic flap by an incision across the anterior part of the shoulder, as in the operation of amputation, which on being turned up leaves the joint exposed. The edge of the knife being applied to the head of the bone in a line below, but immediately under the acromion process, divides the capsular ligament, and with it the long tendon of the biceps, on which the arm drops from the socket or glenoid cavity, and allows the finger to be introduced, when the three muscles inserted into the great tuberosity may be cut through, and the subscapularies, inserted into the small tuberosity, will also be divided.




Sir William Fergusson is of opinion that the surgeon should not limit himself to one mode of procedure, but should rather, trusting to his anatomical and manipulative skill, adapt his measures to the peculiarities of the case. He recommends the adoption of a plan similar to that originally followed by Morel. The patient being seated or laid on his back, an incision should be made with a strong bistoury, commencing opposite the coracoid process, and ending about an inch behind and below the root of the acromion. It should be semi-lunar in shape. The extreme convexity should be about 4 inches under the acromion, and thus the greater portion of the deltoid will be included in this flap. The skin and deltoid being divided, the flap should be drawn upwards, a few touches of the knife being sufficient to separate the loose connections of this muscle. A bold incision should next be made through the tendons attached to the tuberosities of the humerus, dividing them and the capsule at the same time to such an extent as to permit the head of the bone being turned out by a slight twist. This

part should then be laid hold of with the lion forceps by the surgeon or an assistant, and held steady whilst the saw is used to separate as much as may be necessary. If the operation is done for a shattered bone, its head cannot be thrust out like the end of a lever, as thus directed; and therefore the surgeon must make use of his fingers or any convenient hook or forceps to enable him to raise the fragments.

Much of the success in rendering a limb useful after excision of the head of the humerus, depends upon early passive movements, followed up by regular exercises with weight and pulley.

Excision of the Clavicle.—It may be necessary to remove this bone wholly or partially, and to perform the operation it is necessary to make a free incision along its whole length; it should then be disarticulated or sawn through at its acromial articulation and dissected out from without inwards, the sternal end being forcibly twisted outwards and all attachments carefully cut, great care being paid to the numerous small veins in this position.

Excision of the Scapula (Syme's Operation).—Make an incision from the acromion process transversely to the posterior edge of the scapula, and another from the centre of this one directly downwards to the lower angle of the bone. The flaps formed being reflected back, separate the scapular attachment of the deltoid, and divide the connections of the acromial extremity of the clavicle. The division of the subscapular artery will cause a great gush of blood, but it should be caught and secured without delay. The joint and around the glenoid cavity should next be cut into, and the finger hooked under the coracoid process, so as to facilitate the division of its muscular and ligamentous attachments; and then, by pulling back the bone with great force by the left hand, the remaining attachments should be divided with rapid sweeps of the knife.

Excision of the elbow-joint may be performed in three different ways—by a simple longitudinal incision, or by the  or . The longitudinal is the most simple; but if it does not give sufficient room for clearing the bones, it may be formed into the  by a transverse incision directly across the end of the olecranon to the outward side of the joint.

Should the longitudinal incision be selected, it must be of sufficient length to allow of the sides being well apart. The bones should be fairly exposed and cleared to the inner side of the joint. In carrying the incision in this direction, Erischen recommends that "the edge of the knife should always be kept against the bones, and their sinuosities closely followed, so that the ulnar nerve, being dissected out from behind the inner condyle, may escape injury. If the incision be properly planned, and the knife kept in contact with the bone, the nerve ought not to be exposed during the operation, more particularly as it is usually imbedded in a quantity of plastic tissue. When

the posterior part of the joint has been laid bare in this way, the knife should be carried round the tip of the olecranon, and the process removed with cutting pliers. By forcibly bending the joint, pushing the forearm upwards, and lightly touching the ligaments with the point of the knife, the interior of the articulation will be fully exposed. By means of a small narrow saw, the articular end of the humerus is separated from the rest of the bone; the upper end of the ulna and the head of the radius may either be removed in the same way or by cutting pliers."

After the operation, the limb should be laid upon pillows nearly in the extended position; or Esmarch's splint may be applied (fig. 128).

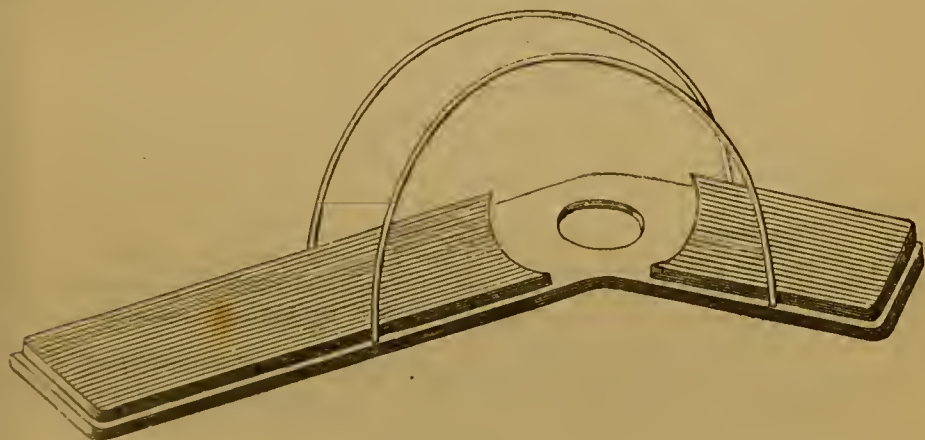


Fig. 128.

This splint, which Dr. Stromeyer designed for the more convenient treatment of excision or resection of the elbow-joint, was improved upon by Professor Esmarch; by means of it the arm can be raised up, without the joint being disturbed. It is made from two of Stromeyer's arm splints, of which the under is uncushioned, but the upper one stuffed with wadding and covered with oil cloth, and at the region of the elbow a wedge-shaped piece is sawn out (fig. 128). The upper arm-piece of this splint is retained in position with the forearm piece by means of two hoops of strong wire. The arm rests on this splint, which can be raised by means of the wire, while the bandages and dressings are quickly removed from the lower splint, and after it has been cleaned and the wound dressed, can be replaced.

Numerous contrivances have been invented for placing the elbow on after resection, but an ordinary soft pillow answers all purposes, on which the limb should rest in nearly the extended position, so that the cut portions of the bones may be in close approximation with one another.

"At the end of a week or ten days, when granulations have sprung up, the arm may be put on a slightly bent leather splint, and as the healing goes on this may gradually be flexed, until at last it is brought to a right angle.

"Until the contraction of the cicatrix has fully taken place, and the neighbouring tissues are quite firm, the joint should be supported by one lateral leather splint on the inner side of the arm. The splint should then be removed, the arm put in a sling, and passive motion had recourse to, in order to prevent osseous ankylosis."

Ingenious splints have been designed by Drs. Hodgen and Volkman Messrs. Butcher and Heath, but an ordinary firm pillow will be found to answer all purposes, care being taken to commence passive motions early, and exercises with weight and pulley as soon as the inflammation consequent on the operation has subsided.

Excision of the Wrist.—This operation is not in much favour with military surgeons. It may, however, be performed in several different ways. In disease, the presence of sinuses on the surface may be taken advantage of and followed up, giving sufficient opening between the extensor tendons and the bones.

Sir W. Fergusson recommends that incisions be made chiefly behind or at the sides, the parts in front being too important to be interfered with. He is of opinion that the operation may be most efficiently performed, and with the best prospects of a satisfactory result, by making a single incision along the ulnar side of the joint.

Professor Lister has adopted a method for excision of the wrist which has given satisfactory results, and which Mr. T. Holmes describes as follows:—
"An incision is made commencing in front over the second metacarpal bone, internal to the tendon of the extensor secundi internodii pollicis, and running along the back of the carpus internal to the same tendon, as high as to the base of the styloid process of the radius. The soft parts, including the extensor secundi internodii, and the radial artery, being cautiously detached from the bones external to this incision, and the tendons of the radial extensors of the wrist being also severed from their attachments, the external bones of the carpus will be exposed. When this has been done sufficiently, the next step is to sever the trapezium from the other bones with cutting pliers, in order to facilitate the removal of the latter, which should be done as freely as is found convenient. The operator now turns to the ulnar side of the incision, and cleans the carpal and metacarpal bones as much as can be done easily. The ulnar incision is now made. It should be very free, extending from about 2 inches above the styloid process down to the middle of the fifth metacarpal bone, and lying near the anterior edge of the ulna. The dorsal line of this incision is then raised, along with the tendon of the extensor carpi ulnaris, which should not be isolated from the skin, and should be cut as near its insertion as possible. Then the common extensor

tendons should be raised, and the whole of the posterior aspect of the carpus denuded, until the two wounds communicate quite freely together; but the radius is not as yet cleaned. The next step is to clean the anterior aspect of the ulna and carpus, in doing which the pisiform bone and the hooked process of the unciform are severed from the rest of the carpus, the former with the knife, the latter with the cutting pliers. In cleaning the anterior aspect of the carpus, care must be taken not to go so far forwards as to endanger the deep palmar arch. Now, the ligaments of the internal carpal bones being sufficiently divided, they are to be removed with blunt bone forceps. Next, the end of the ulna is made to protrude from the incision, and is sawn off, as low down as is consistent with its condition, but in any case above its radial articulation. The end of the radius is then cleaned sufficiently to allow of its being protruded and removed. If this can be done without disturbing the tendons from their grooves it is far better. The operator next attends to the metacarpal bones, which are pushed out from one or other incision and cut off with the pliers so as to

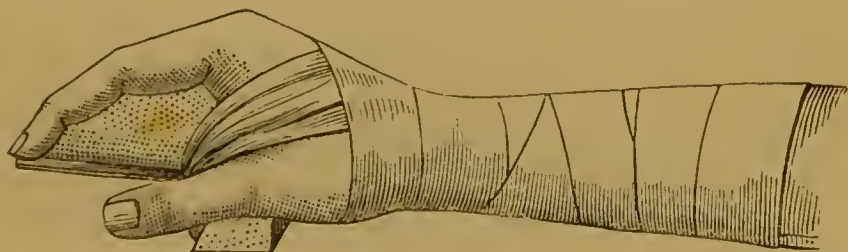


Fig. 129.

remove the whole of their cartilage-covered portions. The trapezium bone, which was left in the early stage of the operation, is now carefully dissected out, so as to avoid any injury to the tendon of the flexor carpi radialis or to the radial artery, and the articular surface of the first metacarpal bone is then exposed and removed. Lastly, the cartilaginous portion of the pisiform bone is taken away; but the non-articular part is left behind unless it is diseased, in which case it should be removed entire. The same remark applies to the hooked process of the unciform.

"In order to ensure motion, particularly in the fingers, passive movements should be performed from a very early period after the operation. For this purpose, Mr. Lister places the limb on a splint with the palm of the hand raised by a large wedge of cork fixed below it, so that the joints of the fingers can be moved without taking the limb off the apparatus," (fig. 129).

Mr. MacCormac reports most favourably on an apparatus of Professor Esnarch for treating cases of resection of wrist-joint. "The hand and arm

are placed in a prone or semi-prone position on the splint (fig. 130), whose form is such as to leave the wrist exposed and easy to be got at for the application of dressings. The whole apparatus *en fonction*, consisting of a suspending rod, a plaster of Paris or other form of bandage, and the splint, is represented in fig. 131, and the facility with which the patient can move about in bed, or readjust the position of his arm, is at once perceived."

Excision of the Carpal Ends of the Bones of the Forearm.—Mr. Skey recommends the following operation:—"The joint is exposed on the dorsal surface by two lateral incisions of 2 inches in length, united by a transverse



Fig. 130.

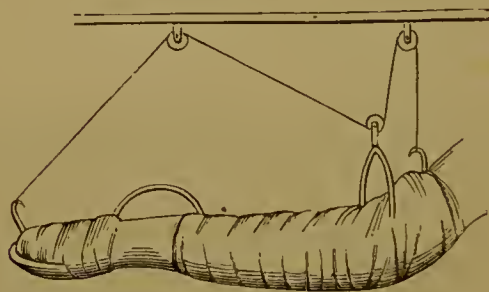


Fig 131.

line made below the projecting bone. The flaps being raised, the tendons are exposed, and should be separated from the radius by a knife passed underneath them in forcible extension of the hand backwards. Along this line the fine blade of a metacarpal saw may be readily passed, which, being jointed at the point, can be fixed to its back after passing across the tendon. The blade of a knife passed half an inch under the radial artery will protect it from injury."

Excision of the Hip Joint.—This operation may be performed by incisions of such shapes as may suit the surgeon's convenience for removal of the damaged bone; and in the event of the injury being from a gun-shot, there will be an open wound which may be extended. There are, however, certain

methods laid down by different authorities. Professor Gross prefers a semi-lunar flap of the gluteal muscles with the convexity downwards. This plan of incision, he considers, has the advantage, not only of allowing free access to the joint, but also of affording a ready outlet for the discharges. The superior extremity of the femur being thus exposed, is thrust out of the opening by carrying the limb across the sound one, rotating it inwards, and then pushing it up, when it is to be divided by means of a narrow saw. The great trochanter, however sound, should always be included in the operation, otherwise it will be sure to interfere more or less seriously with the healing process by projecting into the wound, and obstructing the discharge.

Mr. Skey describes two methods for excision of the head of the femur : the anterior and posterior. The former may be here described, the latter differing but little from others. The situation of the femoral artery being marked in ink by an external line, a straight incision is made from about an inch below the trochanter major, along the line of the neck towards the acetabulum, stopping short of the nerves by at least half an inch. The neck being bared, and capsule opened, the operator will be able to ascertain the extent to which he can command the part to be removed. If necessary, a second incision may be made backwards across the neck of the bone. Mr. Skey gives preference to the posterior operation, which is safer and easier of execution.

Sir William Fergusson remarks on this operation : " Like resection of the head of the humerus, many different methods of exposing the upper end of the femur have been recommended." He holds the opinion that a knowledge of anatomy will best enable the surgeon to suit the proceeding to the peculiar features of each case. It would be folly to make a larger wound than is required for the due performance of the operation ; and as long as the operator limits himself—in front, so as not to meddle with the branches of the crural nerve, or endanger the femoral arteries ; and behind, so as to protect the sacro-sciatic nerve—it seems to him of little consequence what lines are cut on the surface. A straight one will, he believes, answer in general, but, with the views inculcated, it matters not what shape the flaps may be.

Many splints have been designed for the after-treatment of excision of the head of the femur. For permanent hospitals, Mr. Sayer's splint (wire breeches*) is perhaps the best ; but for field hospitals, where appliances may have to be extemporised, fig. 132, which is similar to Mr. Erichsen's appliance, seems well adapted, and can be easily made. To secure quietude, a certain amount of extending force, and the straightening of the limb, should be the surgeon's aim.

In treating a case of excision of the head of the femur at Netley, I adopted the stretcher and bed as represented in figs. 133, 134, which answered to my entire satisfaction.

* " British Medical Journal," July, 1871.

The *stretcher* (fig. 133) consists of a substantial beech or ash frame with handles, and of such a size that, when placed on the mattress, the woodwork falls over its sides, and does not come in the way of the patient's arms or the hands of the attendants.

The canvas bottom is divided into five portions ; the three centre are 6 or 8 inches wide ; these are attached to the framework on one side by means of straps and studs, and on the other by straps and buckles, by which they may be pulled tight. They are removable at will, and enable the surgeon

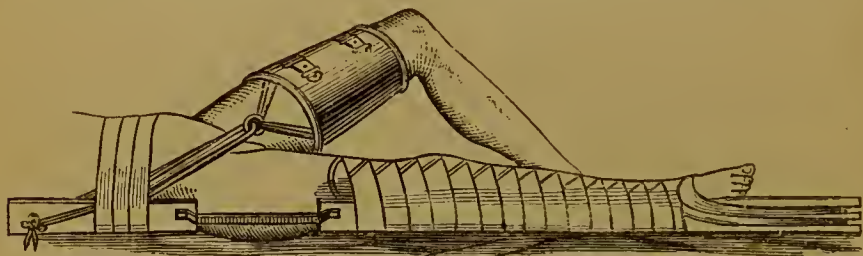


Fig. 132.

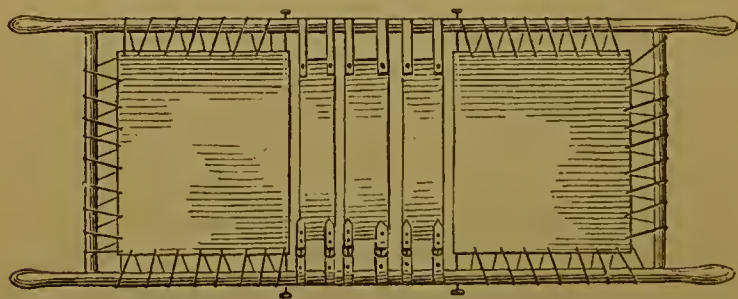


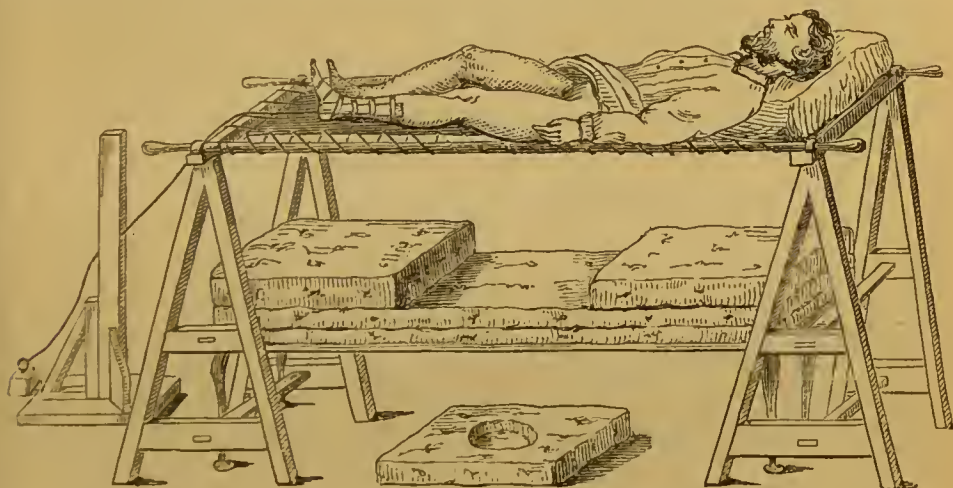
Fig. 133.

or attendant to dress the wound when the stretcher has been raised. The canvas at the top and bottom of the stretcher may be secured by cords, or straps and buckles, so as to admit of being removed for cleaning. Two movable tressels have to be made for the stretcher to be placed upon when necessary.

The advantages which this stretcher possesses are that, from the moment the patient is placed on it, he need not be disturbed, as by simply raising it, placing it on the tressels, and removing one of the strips of canvas, the wounds may be dressed and excreta removed. The patient may be carried

from one room to another or into the open air without the least disturbance ; and, in the event of there being a bedsore, the stretcher may be placed on tressels for a short time and the parts relieved from pressure.

The bed speaks for itself, as represented in fig. 134, the chief features in it being the firm foundation for the mattresses by having the bedstead boarded. The top mattress is divided into three portions, the centre one of which has a round hole 10 inches in diameter in its centre, into which the



E.V.S.

Fig. 134.

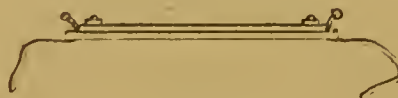


Fig. 135.

patient's nates fit. This centre piece may be removed to facilitate dressing, as represented in the illustration.

Fig. 135 represents a crossbar arranged with straps and buckles at each end, intended to insert between the sides of the stretcher, so as to prevent their bowing inwards when the straps attached to the canvas are pulled tight. It may be brought into use by gently moving the head portion of the top mattress, so as to allow of its being inserted underneath the stretcher.

Sir W. Fergusson recommends that the extension should be made from the opposite thigh (fig. 132), round the upper part of which a socket is

fixed, to which the band is attached. The splint being bracketed, dressings can be applied with ease, and extension made by means of a weight.

Excision of the Knee.—In excising the knee-joint for gun-shot injuries, the army surgeon may be able to take advantage of a wound already existing in forming his incisions, instead of adhering to any plan of incision as laid down in civil practice. He has, however, many plans to select from : such as the straight transverse incision ; two parallel incisions, one on each side of the patella ; an **H**-shaped incision ; a horse-shoe incision ; or, as Mr. P.

Watson recommends, “a semi-lunar incision, raising a long flap from the anterior surface of the articulation.”

Mr. Holmes describes an operation which appears to the writer to have many advantages ; it is as follows :—“An incision should be made from the back part of one condyle to the back part of the other, passing across the front of the limb below the patella, and slightly convex downwards. It is seldom necessary to make any other incision in the skin ; but if there is much thickening about the soft parts, perpendicular incisions may be made at the ends of this, so as to form the **H**-shaped incision, which used always to be employed in this operation. The ligamentum patella is to be divided in the first incision ; then the soft parts are to be thrown back from the patella and the end of the femur, and the patella is to be removed. The joint is now to be freely opened by cutting at the sides of the condyles, so as to sever completely both lateral ligaments ; and then the knife is to be carried round the posterior surface of the end of the femur, care being taken in doing this to thrust the femur out of the wound as much as possible, by an assistant forcibly flexing the limb, and to keep the edge of the knife directed towards the bone, and guided by the finger, so as to avoid the popliteal artery, which here is separated from the bone only by some fat and loose tissue ; and in sawing the bone, it may be advisable, if the femur have not been very completely cleaned, not to pass the saw entirely through the osseous tissue, but rather to break than cut the outer lamella at the back by using the saw as a lever. The end of the femur having been removed, the head of the tibia is to be cleaned and sawn horizontally, care being taken in young persons to keep close below the cartilaginous surface, so that the epiphysal line be not interfered with.

“In cases where there has been no dislocation, nor much alteration in the shape of the bones from previous disease, there is now usually no impediment to placing the limb in the straight position, with the bone in accurate adjustment. Otherwise they must be adjusted by taking off successive pieces from the end of the femur or tibia (if possible without going beyond the epiphysis) ; and in cases of old dislocation it is often necessary to sever some of the hamstring tendons.

"The parts should, in all cases, be adjusted in perfect position upon a splint, and the bandage firmly applied before the patient is moved or allowed to recover from the chloroform. If the femur appears at all prominent, a stout splint should be applied in front in order to counteract the tendency of the leg to gravitate backwards (which is also assisted by the action of the flexor tendons); and it is at any rate a useful precaution to apply a long side splint to the outer side of the limb, which can be discarded after the first few days, if it appears superfluous." Mr. Holmes has found much comfort to the patient from suspending the whole apparatus in a "Salter's swing." He uses splints which are interrupted and bracketed with iron at the seat of operation, so as to give access to the wound.

Numerous splints and plans of dressing have been designed for the after-treatment of excision of the knee. Mr. Butcher recommends a box splint; though inferior to apparatus now in use, this surgeon has turned out many good cases with it. "It consists of two side splints, the outer one extending from the axilla to below the foot, the inner from the groin to below the foot and attached to a back piece. The sides are on hinges, so as to admit of letting down for dressing" (fig. 136). This splint has been objected to on

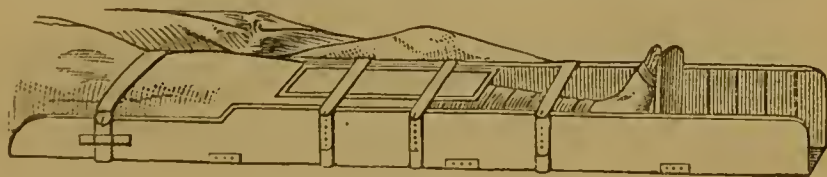


Fig. 136.

account of its being of wood, and absorbing the discharges; it is also very cumbersome, and cannot be swung; and in order to get at the sides of the wound, a portion, if not the entire retentive apparatus, must be undone. However, being easily constructed, it appears well adapted for active service.

Mr. P. Watson has designed a splint for excision of the knee, which has received wide reputation. "It consists of two parts—1. A suspension-rod, made of iron, about the size of No. 5 of trade wire gauge; 2. A modelled Gooch splint, long enough to extend from tuberosity of the ischium to beyond the heel.

"The suspension-rod extends from the groin to the extremities of the toes, and is bent to the outline of the limb, departing from it only in the situation of the excision, where it forms a bow or arch. To the upper surface of the rod are attached one or more hooks by which the suspension is effected (fig. 137).

"The Gooch splint should not be made too wide, and should certainly not surround the thigh and leg to more than two-thirds of their circumference.

It should be scooped away laterally, at a part corresponding to the site of the excision, and should have an aperture cut corresponding to the tendo-Achillis and heel (figs. 138, 139). The inferior extremity of the splint is thus of a horse-shoe or stirrup shape, and admits of the ankle and foot being supported by the lateral horns of the splint, as they fold on each side of the malleoli, without the risk of inordinate pressure being made upon the tuberosity of the os calcis. In application, the limb is first laid and carefully adjusted upon the posterior splint, which should preliminarily be padded



Fig. 137.



Fig. 138.—Posterior "Gooch" splint of ordinary form.

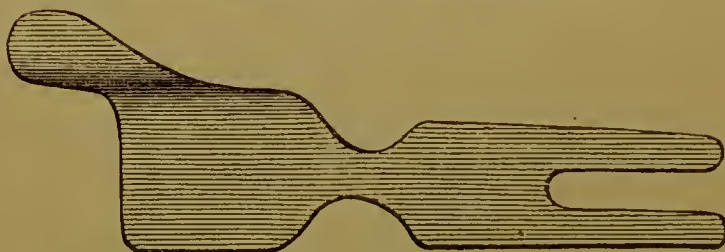


Fig. 139.—Alternative form of "Gooch" splint, the rounded part above adapted to the os innominatum, and secured by means of strips of adhesive plaster.

with lint, and covered with gutta-percha tissue or hot paraffine, in the situation which corresponds to the site of operation. The iron rod is then placed in front, and folded lint laid between it and the limb at the groin (where the rod terminates above), at the upper part of the tibia, and at the bend of the ankle. These two parts of the apparatus are then retained in contact with the limb by means of an open-weave roller bandage applied from the toes upwards, the site of the incision alone being left uncovered. The whole is then rendered immovable by means either of plaster of Paris applied by

the hand, of a consistence like thick cream, or of paraffine, which, having been rendered temporarily liquid by heat, is applied by a large painter's brush. When the application has solidified, the patient may be removed to bed, and the limb suspended from Salter's swinging cradle, or from the roof-bar of the common iron-wire cradle employed to support the weight of the bed clothes.

Mr. Butcher performs the operation with the **H** incision, and recommends that the perpendicular strokes be placed well back, so as to allow all fluids and discharges to drain off; and adds that they are far more effective and safer than any opening made in the popliteal space. The patella should be taken away in all cases, whether diseased or not. All bleeding vessels should be tied, or any that have sprung and retracted should be drawn out and secured. While the patient is yet on the operating-table, the limb should be placed in the horizontal position, either by gentle and steady traction, combined with pressure of the cut surfaces of the bones backwards, or, if necessary, the division of the hamstring tendons.

During the adjustment of the bones, great caution should be exercised that their surface be throughout their extent in contact, and that no soft parts intervene. The limb should not be disturbed for several days. In cases where large abscesses form in the vicinity of the excised joint, or up along the thigh, Chassaignac's drainage tubes may be used with the best possible hopes of success. The free administration of stimulants is imperatively demanded in all cases of excision, regulated to a certain extent by age, sex, temperament, and habit.

Excision of the Ankle.—For removal of the entire joint Mr. Handcock devised the following method: "The foot is first laid on its side, and an incision is made over the lower 3 inches of the posterior edge of the fibula. When it has reached the lower end of the malleolus, it forms an angle, and runs downwards and forwards to within about half an inch of the base of the outer metatarsal bone. The angular flap is reflected forwards; the fibula, about 2 inches above the malleolus, is sufficiently cleared of soft parts to allow cutting forceps to be placed over it; and the bone is then nipped in two and carefully dissected out, leaving the peroneus longus and brevis tendon intact. The foot is now to be turned over. A similar incision is made on the inner side, the portion on the foot terminating over the projection of the inner cuneiform bone. The flap is to be turned back, and the sheaths of the flexor digitorum and posterior tibial tendons exposed, the knife being kept close to the bone, avoiding the artery and nerve. The internal lateral ligament is then to be severed carefully close to the bone; and now the foot is twisted outwards, and the astragalus and tibia will present at the inner wound. A narrow-bladed saw, put in between the tendons into the inner wound, projects through the

outer. The lower end of the tibia, then the top of the astragalus, may be sawn off in a proper direction. The only vessel that may require tying is one of the lower branches of the peroneal artery. The wound may be closed with sutures, except that part opposite the breach of osseous matter; the leg and foot placed on a splint with foot-board, and cold water applied."



Fig. 140.

Mr. Guthrie recommends the following method for excision of the ankle: "Begin the incision behind the external malleolus, an inch and a half above its lower extremity, and carry it downwards and then forwards across the front of the ankle-joint (fig. 140), then under the internal malleolus and upwards, close behind the process, the extent of an inch and a half; this incision should merely divide the skin, and should not, on any account, wound the subjacent parts. Raise the flap thus made, and, placing the leg on its inside, detach and turn aside the peronei tendons from the groove behind the external malleolus. Cut through the external lateral ligaments of the ankle-joint, keeping the knife close to the end of the fibula; then with the large bone scissors, or nippers, cut through the fibula from one-half to three-quarters of an inch above its junction with the tibia,

and, after dividing the ligamentous fibres connecting the two bones, remove the malleolus externus. Turn the leg on to its outer side, and cut through the internal lateral ligament close to the tibia, to avoid wounding the posterior tibial artery; this will allow the foot to be dislocated outwards, and the lower end of the tibia to be brought well out through the wound. An assistant keeping the foot and tendons out of the way, the lower end of the tibia is to be removed with a fine saw to the same extent as the fibula, or as high as the injury or disease requires. The articulating surface, or injured part of the astragalus, is then to be removed, after which the foot is to be returned to its proper position, and the cut surfaces of the tibia and astragalus brought into close approximation, and so kept by suture, strapping, and bandage. The limb is to be placed on an outside leg-splint, having a foot-piece to it."

Professor Esmarch has designed a splint for the after-treatment of excision or resection of the ankle-joint; he found the great utility of such an apparatus for resection of the elbow-joint, and in consequence applied it to the ankle.

It consists of a strong piece of iron wire placed in front of the limb, extending from the toes to the groin, and bent at convenient angles to suit the front of the ankle and the knee, taking care that an arch is formed

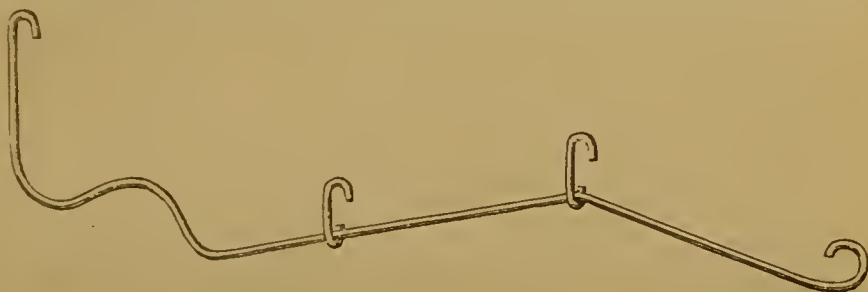


Fig. 141.



Fig. 142.

with it immediately above the seat of operation. Hooks should be formed with the wire at either end, and 2 or 3 loose ones attached for the purpose of suspension (fig. 141). Underneath the limb should be placed a wooden splint, hollowed out and cut to an angle to correspond with the bend of the knee. Firmly secured to this is a foot-board, placed at right angles, which gives support to the foot, and forms a base for the plaster of Paris bandage (fig. 142).

In using the apparatus, the wooden splint should be most carefully

cushioned and applied, especially about the heel and foot, where any undue pressure may be attended by most serious consequences. The plaster of Paris bandage should then be applied in the usual manner, an opening being left at the seat of the wound for the purpose of applying dressings. Fig. 143 represents the splint applied and suspended.

Professor Esmarch says he has applied this apparatus in cases of resection of the ankle-joint for six or seven weeks, and that the patients have never once had to complain of aches or pains, and that the advantages of these suspension splints are so great that he recommends them most earnestly for war service, as well as in time of peace.

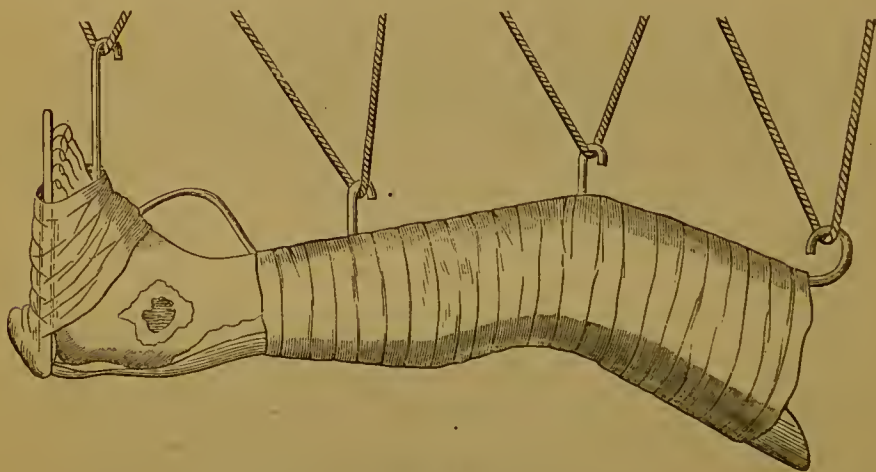


Fig 143.

Excision of the Os Calcis.—"The patient lying on his face, a horseshoe incision is carried from a little in front of the calcaneo cuboid articulation round the heel, along the side of the foot, to a corresponding point on the opposite side. The elliptic flap thus formed is dissected up, the knife being carried close to the bone, and the whole under-surface of the os calcis exposed. A perpendicular incision, about 2 inches in length, is then made behind the heel, through the tendo-Achillis, in the mid-line and into the horizontal one. The tendon is then detached from its insertion and the two lateral flaps are dissected up, the knife being kept close to the bones, from which the soft parts are well cleared. The blade is then carried over the upper and posterior part of the os calcis, the articulation is opened, the interosseous ligaments are divided, and then, by a few touches with the point, the bone is detached from its connection with the cuboid. This bone,

together with the astragalus, must then be examined ; and if any disease be met with, the gouge should be applied."

Excision of the Astragalus.—"A curved incision should be made from one malleolus to the other, something like that made at the beginning of Syme's amputation. The ankle-joint is then to be laid freely open, and the whole upper part of the diseased bone exposed. Then the ligaments connecting it to the scaphoid are to be severed, and the bone is to be levered up, when the interosseous ligament connecting it with the os calcis will, if entire, be felt, and can be readily divided. All that is then necessary to complete the operation is to clean the back part of the bone, which should be done with care, in order to avoid injury to the tendons and vessels which lie near it.

"The bone might also, no doubt, be removed by two lateral incisions similar to those used in excision of the ankle. This would avoid the injury to the tendons and vessels incidental to the above method ; but would be more laborious."

Excision of other Tarsal Bones.—"No formal directions are required for excising the other *tarsal bones*. The soft parts are to be thrown aside by crucial incisions, radiating from the sinuses which lead to the diseased bone, and the latter removed ; care being taken, in all cases where it is possible, to excise the whole bone with the articulating surface."

Excision of the Shafts of Long Bones.—"This operation may be partial, or it may be necessary to remove the whole bone.

As far as practicable, the subperiosteal operation should be performed. An incision sufficiently long to admit of the working of the chain-saw should be made along the superficial aspect of the bone, when the periosteum must be detached with the handle of the scalpel, raspatory, or chisel recommended by M. Ollier, or other instruments suited for that purpose. A chain-saw may then be passed under the bone, the shaft divided, and the separated portion, being seized with a strong forceps, carefully detached.

The subperiosteal operation for excisions and resections has been recommended by many in consequence of the bone being reproduced to some extent, and tendons and muscles detached entire from the bone. It, however, has its disadvantage in being tedious ; the periosteum, too, is liable to slough. It is doubtful if the reproduction of bone is a benefit, at least in resection of the joints, and it is frequently difficult to remove the diseased bone without detaching the periosteum from the healthy.

Extirpation of the Eye.—Mr. J. Dixon for extirpation of the eye-ball, inserts the spring speculum between the lids, and with a curved scissors makes the usual circular incision of the conjunctiva. He then grasps the external rectus and its surrounding tissue with a forceps and snips them through ; an assistant at once seizes the cut tendon close to its insertion, and draws the eye inwards.

By sliding one blade of the scissors under the superior oblique and rectus muscle, they can be first divided, and then the inferior rectus. The optic nerve is next snipped through, and the globe starts forward. A few strokes of the scissors divide the inferior oblique, internal rectus, vessels, and bands of areolar tissue.

AFFECTIONS OF STUMPS.

Affections of stumps may be divided into primary and secondary.

The *primary* consist in hæmorrhage, spasm of the muscles, excessive pain, undue inflammation, osteo-myelitis, and inordinate retraction of the soft parts exposing bone.

The *secondary* consist in necrosis, neuralgia, strumous degeneration, fatty degeneration, aneurismal enlargement of vessels, exfoliation of bone, and contraction of the tendons in the neighbourhood of the stump.

With regard to the treatment of these affections,—

a. Hæmorrhage will be considered under that head, p. 225.

b. Spasms of the muscles may be relieved by shifting of position, laying the hand lightly on the stump, or by the administration of anodynes.

c. Excessive pain must be relieved by anodynes.

d. Undue inflammation may be relieved by the application of cold, as from an irrigator, or by light warm poultices, application of leeches, and the administration of salines, care being taken not to induce vomiting or excessive purgation.

e. Osteo-myelitis has been considered under that head.

f. Inordinate retraction of the soft parts, exposing bone. Nothing can be done for this until the inflammation consequent upon the operation has subsided, when it will be necessary to open up the stump, and remove the exposed bone.

g. Necrosis. The stump must be opened, and bone removed high up.

h. Neuralgia. Soothing anodyne applications, such as opium, belladonna, or stramonium.

i. Strumous degeneration. Secondary amputation may be advantageously performed.

j. Aneurismal enlargement of the vessels is very rare. Mr. Cadge has reported one case of it.

k. Exfoliation of the bone. As little interference as possible, since in time the dead portion will be thrown off.

l. Contraction of the tendons in the neighbourhood of the stump. If causing inconvenience, and giving annoyance, the tendons may be divided.

m. Maggots in stumps have been already considered, p. 183.

HÆMORRHAGE.

THE occurrence of hæmorrhage from wounds in war may be divided into primary or immediate, intermediate, and secondary.

Some writers on military surgery are of opinion that *primary hæmorrhage* to a dangerous extent is comparatively rare, and it is generally admitted that few cases come under the notice of surgeons on the field of battle; this, however, may be in consequence of severe injuries to large arteries proving fatal almost immediately, and the sufferers do not then come under the notice or observation of the surgeon. Mr. Hamilton, of the U.S.A., remarks: "It is one peculiar feature of gun-shot injuries, that in proportion to the number and severity of accidents, profuse arterial hæmorrhage is rare. The wounds inflicted by the missiles employed are generally contused and lacerated, seldom incised; and the same general laws as to bleeding, which govern contused and lacerated wounds elsewhere, and from other causes, govern here."

I experienced only one fatal case from hæmorrhage among many wounded who came under my notice during the siege of Sevastopol and during other services. A brother officer was wounded in the right axilla, dividing the axillary artery. The night was very dark, he was warmly clothed, there were no lights to examine the nature of the wound, and he had to be carried a considerable distance before he could be attended to. On reaching the camp hospital, it was found the poor fellow had expired from hæmorrhage.

Dr. Valentine Mott is of opinion that many men perish on the field from hæmorrhage, or are so much reduced as to preclude all chance of recovery.

Wounds of Arteries.—Arteries, when wounded by extremities being torn off by round shot or shell, seldom bleed. Nature endeavours to establish a cure by the inner and middle coats of the vessel contracting, and subsequently by adhesive inflammation.

When a large vessel is only partially injured, the hæmorrhage from it may prove fatal in consequence of this contraction not taking place.

An artery is liable to be seriously injured by a blow or contusion giving rise to narrowing of its calibre, which might with other injuries occasion gangrene of the limb; a bullet has in this manner passed between an artery and a vein without opening either, but causing gangrene of the limb. When the principal artery of a limb is obstructed from any cause, no cold or constricting bandages or plasters should be applied to it, but a flannel bandage may be rolled round it, and gentle friction applied so as to increase its temperature and establish collateral circulation.

An artery may receive such injury from contact with a missile as to *produce arteritis*, characterised by tenderness along the course of the vessel, cessation of pulsation in its terminal branches, intense pain in the limb, and possibly followed by dark dry gangrene.

The treatment will have to be regulated according to the stage of the disease. If seen early, antiphlogistic treatment may subdue the inflammatory action; otherwise, amputation must be performed at the point of obstruction, should gangrene have taken place.

Bullets have been known to pass between an artery and a vein, injuring both and establishing a communication, causing what is known as an *aneurismal varix*. Surgical interference is not recommended in such accidents, unless a very large tumour is formed, which is likely to give way and endanger the life of the patient, when the artery should be cut down upon, and a ligature applied on each side of the wound.

Lacerations of the inner coats of an artery may be caused by considerable violence, which may also give rise to gangrene, or at a later period to dissecting aneurism.

The external or middle coats of an artery may be cut or torn through, while a thin, undivided, inner portion preserves the integrity of the canal. In such an accident the arterial trunk should be tied without delay, though there be no hæmorrhage.

Punctured Wounds of Arteries.—Guthrie recommends that in all cases of punctured wounds, when pressure can be effectually made, and especially against a bone, it should be tried in a graduated manner over the part injured, in the course of the artery above and below the wound; and, if in an extremity, over the whole limb generally, the motions of which should be effectually prevented, and absolute rest enjoined if the artery is of importance. This should be continued for two, three, or more weeks, according to the nature of the injury.

Diffused traumatic aneurism may be the result of a wounded or ruptured artery; the blood is poured out into the surrounding tissue, but is limited in its extent by coagulation and pressure of the neighbouring parts. There is no sac. The treatment in these cases is to lay open the tumour, remove coagula, and ligature the vessel above and below the wound in it.

Circumscribed traumatic aneurism may be induced in two ways from wounds of arteries:—

First: A vessel having received a puncture, the external wound heals, the blood is extravasated into the neighbouring tissue; this becomes dense and firm, is surrounded by layers of fibrine, and from continued pulsation a sac is formed. This form of aneurism is liable to occur in punctured wound of the palmar, radial, ulnar, and temporal arteries.

The treatment should be, if a small artery, to lay the tumour open, remove coagula, and ligature the artery at the seat of injury. It may, how-

ever, be necessary to tie the main trunk in the event of the vessel being very large, which should be done close to the sac.

The second form of circumscribed aneurism may be induced from a similar wound, as above, but both external wound and wound of artery heal, the cicatrix of the latter becomes weak and gradually dilates from the pulsations; or it may be produced by a bullet bruising the artery and weakening its coats. A tumour is formed which may attain a considerable size. This form of aneurism is more likely to occur in large arteries, such as the axillary, femoral, and carotid.

The treatment recommended is to try and consolidate the tumour by pressure on the main trunk. If this does not succeed, the vessel may be ligatured at the tumour, or it may be necessary to ligature the main artery at a distance from the sac.

Should the sac be very large and likely to give way, or should it give way, the practice recommended is to lay it open, turn out coagula, and ligature the artery above and below the wound.

The following rules with regard to the treatment of wounded arteries are now generally adopted, for some of which I am indebted to Mr. C. H. Moore (see *Holmes' System of Surgery*, vol. i. p. 749).

Wounded arteries which do not readily cease bleeding, and which can be conveniently secured, should be tied.

Moderate hæmorrhage from an artery which cannot be reached without enlarging the wound, should be stopped by a graduated compress, compression upon the arterial trunk above the wound may be added if it is thought advisable. Violent arterial hæmorrhage requires the wound to be enlarged and the vessel tied.

No operation should be performed with the object of securing a wounded artery unless it be actually bleeding. This rule has been specially laid down by Mr. Guthrie; nevertheless, it may be departed from when the torn extremity of a large artery is seen or felt to pulsate, and its permanent closure by natural means appears doubtful. An artery which has recently ceased to bleed may also be cut down upon and tied in certain emergencies. Such practice may be judged to be right, when delirium tremens supervenes upon the injury, or when, as in some military movements, the wounded are ordered to be transported to another position. Mr. Holmes considers this rule may be departed from in cases in which the surgeon judges, by the severity of the previous bleeding, that a large vessel has been wounded that the hæmorrhage will probably recur, and when the patient must be left at a distance from competent aid.

A wounded artery when requiring a ligature should be tied in the place where it bleeds; nevertheless, since it is sometimes impracticable to tie the vessel in the wound, the trunk should then be secured at the next convenient place above the bleeding orifice. Mr. Guthrie inculcated this principle, and

says : " No operation is to be done for a wounded artery in the first instance, but on the spot injured, unless such operation not only appears to be, but is impracticable."

The greater number of competent authorities of the present day agree with Mr. Guthrie in his recommendation to cut down directly upon the wounded part of the injured artery, for the following reasons :—That the ligature of the main trunk at a distance above it would only stop the direct supply of blood to the limb ; but it would not interfere with the anastomosing circulation, and blood would find its way to the distal aperture of the artery ; that it may not be possible for the surgeon to ascertain the exact artery the bleeding is coming from unless he looks for it, and instances have been known where main trunks of arteries have been tied, and the hæmorrhage has been from some small vessel unconnected with it. Stromeier is of opinion that the plan of tying a wounded artery at the spot often does very well in minor vessels, but it frequently fails in the femoral artery. The large vein accompanying the artery has often been torn or bruised by the same bullet. After tying the artery at the spot, the vein often becomes totally impervious, and the hæmorrhage recurs, or the limb becomes gangrenous. It may be proper, in some cases, to gain time by putting a ligature above the wounded spot ; before new hæmorrhage occurs, the vein may have undergone a favourable change. In other cases it is better to amputate.

The external wound should be taken as the guide for the incision, and it is recommended that "*in cutting down on a wounded artery*, a large probe should be passed to the bottom of the wound, and taking this as a centre, a free incision should be made in such a direction as may best lay open the cavity with the least injury to the muscles and soft parts. After turning out any coagula contained in the wound, and clearing it out as well as possible, the injured vessel must be sought for." Great care should be observed in ligaturing the vessel in consequence of the altered condition of the structures, from inflammation or infiltration.

The operation may be greatly facilitated by the application of Esmarch's bandage. Should the wound in the vessel not be apparent, it is only necessary to loosen the bandage, when the jet of blood will declare its position. The artery, when found, should be tied or twisted both above and below the wound in it. The necessity for tying the lower end is the greater, because it is the more frequent source of secondary hæmorrhage.

When the lower end of the vessel cannot be found, a piece of compressed sponge, left in the wound, sometimes prevents subsequent hæmorrhage. It is not advisable to apply a single ligature immediately below the origin of a large branch.

Intermediary hæmorrhage may occur some hours after receipt of wound, or as soon as the patient becomes warm, and reaction is completely established.

Secondary hæmorrhage is common in gun-shot wounds due to sloughing of the parts injured, or the reopening of a wound in which a vessel is temporarily closed. It may occur from the fifth to the twenty-fifth day after the infliction of an injury.

It may be produced by local or constitutional causes, the former being any movement which may disturb the wound or increase the rapidity of the circulation: as, for instance, (a) by transporting wounded too soon, which is sometimes unavoidable; (b) by the imperfect application of a ligature; (c) by sloughing or ulceration of a large vessel; (d) by projecting spiculæ of bone injuring a vessel, which has taken place at a remote period; (e) by peculiar *hæmorrhagic diathesis*, which exists in some persons, but on service in the field generally presents itself when the men are worn out by fatigue and privation; this some authorities believe to be due to pyæmic poisoning, whether attended or not by phlebitis or thrombosis.

Legouest remarks on this latter form of hæmorrhage: "Inasmuch as the troops are subjected to protracted hardships, so do their powers of resistance diminish. At the same time that the general health and constitution of the soldier are affected, his wounds heal less rapidly, or take on characters of a grave nature; operations become less successful, and secondary hæmorrhages enter more into the non-success of surgery, practised under circumstances becoming progressively more and more disadvantageous."

Stromeyer describes it as paranchymatous hæmorrhage, and has pointed out that the bleeding often takes place in consequence of an impediment which affects the circulation, in a part whose large vein or veins are obstructed by thrombosis. This bleeding may be venous, arterial, or capillary. It often occurs in pyæmia, but may also occur without it.

Treatment of Secondary Hæmorrhage after Gun-shot Wounds.—When severe the surgeon will have to cut down on the wounded artery and tie or twist both ends, or tie it in its continuity leading to the seat of the bleeding. Some authorities advocate dealing with the main trunk. Stromeyer and MacCormac are opposed to this practice, such operations having been uniformly unfavourable in their experience; they are more in favour of amputation in cases of secondary hæmorrhage. When not severe, it will probably be restrained by pressure and the elevation of the part. Pressure, when selected, should be applied directly on the bleeding point, by graduated compresses and bandages, and it will be of advantage, too, if it be put on the main artery or arteries leading to the aperture. In some parts of the body, as at the root of the neck, the surgeon cannot do otherwise than trust to pressure. When the vessel is small, some ordinary styptic may suffice to arrest the hæmorrhage, particularly if combined with pressure.

Hæmorrhage from Stumps.—Hæmorrhage occurring from stumps may

take place a few hours after the ligature has been applied ; about the period of the separation of the ligature ; and at any period after.

In the first instance it may occur from reaction or from disease of the arterial coats, giving a certain amount of warning by general oozing ; or, in flap operations, where an oval opening having been made in the arteries the whole lumen of the vessels has not been included in the ligatures.

When it occurs at a later period, it may be from causes interfering with the formation of the coagula, or producing ulceration of the coats of the artery, or the stump may be irritable and inclined to slough.

The treatment of hæmorrhage from a stump at an early period must be prompt ; the maxim that held good in primary hæmorrhage—not to interfere with a vessel unless it bled, will not answer here. Bleeding having occurred more than once, active measures must be adopted. After having tried elevation of the stump, the application of tourniquet, pressure by means of bandaging the stump so as to press the flaps together, and the application of cold to the wound and the adjoining parts, without checking the hæmorrhage, it will be necessary to open the wound, and make a search for the bleeding vessel.

It frequently occurs that there is some difficulty in isolating a bleeding vessel in a stump. It may then be secured by passing a curved tenaculum through the tissues immediately surrounding the vessel, and placing a strong ligature around the whole. It may also be secured by thrusting a needle armed with a ligature through the tissue in the direction of the bleeding vessel, and endeavouring to seize it along with the surrounding tissue.

If the vessels are softened, and will not hold the ligature, success sometimes attends the application of the solution of the perchloride of iron or the actual cautery.

In bleeding from a stump where the interosseous artery of the leg has been divided high up, hæmorrhage has been suppressed by a long acupuncture needle being passed through the stump, so as to press the artery against one of the bones.

Should hæmorrhage occur at a later period, when the ligature might be expected to come away, and the stump is irritable and inclined to slough, the surgeon may select one of the five following alternatives : Apply tourniquet ; open up the stump and tie the vessels ; ligature the main artery immediately above the stump ; tie the vessel high up in the limb at a distance from the stump ; or lastly, amputate. Mr. Guthrie remarks on this description of hæmorrhage : “ In irritable and sloughing state of stump, hæmorrhages frequently take place from the small branches, or from the main trunks of the arteries in consequence of ulceration ; and it is not always easy to discover the bleeding vessel, or when discovered to secure it on the face of the stump ; for as the ulcerative process has not ceased, and the end of the artery which is to be secured is not sound, no healthy action can take place ; the

ligature very soon cuts its way through, and the hæmorrhage returns as violently as before, or some other branch gives way. Some surgeons," he says, "have, in such cases, preferred cutting down upon the principal artery of the limb, in preference to performing another amputation, even when it is practicable; and they have sometimes succeeded in restraining the hæmorrhage for a sufficient length of time to allow the stump to resume a more healthy action. This operation, although successful in some cases, will generally fail, and particularly if absolute rest cannot be obtained, when amputation will be necessary. The same objection of want of success may be made to amputation; on a due comparison of the whole attending circumstances, the operation of tying the artery in most cases is to be preferred in the first instance, and if that prove unsuccessful, then recourse is to be had to amputation; but this practice is by no means to be followed indiscriminately.

"To obviate all doubt, the parts from which the bleeding comes should be well studied, and the shortest distance from the stump at which compression on the artery commands the bleeding, carefully noted; at this spot the ligature should be applied, provided it be not within the sphere of the inflammation of the stump. In case the hæmorrhage should only be restrained by pressure above the origin of the profunda, and repeated attempts to secure the vessel on the surface of the stump have failed, amputation is preferable to tying the artery in the groin, when the strength of the patient will bear it."

When hospitals are crowded and badly ventilated, hæmorrhage frequently occurs from the face of stumps, giving rise to great anxiety and trouble. This is no doubt due to constitutional debility, and will have to be treated accordingly.

Intermittent Hæmorrhage.—A remarkable case of intermittent hæmorrhage, apparently due to malarial influence, occurred to a weakly soldier under my own care at Netley. He had suffered in India from severe fever and ague, which culminated in disease of the left knee-joint, for which I amputated the leg through the condyles (Carden's method). The case progressed satisfactorily till the eighth day, when hæmorrhage from the stump set in, at intervals preceded by the cold and hot stages of ague. The usual local and constitutional remedies were tried without success, until sulphate of quinine was administered, when the hæmorrhage ceased as well as the paroxysm of ague, and the man rapidly recovered.

Expedients for suppressing hæmorrhage may be divided into temporary and permanent, and as operating either indirectly on the trunks conveying the fluid to the point, or directly on the orifice of the bleeding vessel.

In case of severe hæmorrhage on the field of battle, the first impulse on the part of the surgeon or his attendant is to check the bleeding by placing his fingers in the wound, or applying a tourniquet to the main trunk. The

latter may not be available ; it would, therefore, be necessary for an attendant to apply pressure with his fingers even during transport, in the event of the bleeding being from a large vessel.

Bleeding can frequently be checked by *plugging* a wound ; but this may be followed by grave symptoms, in consequence of the blood becoming diffused, giving rise to an aneurism or to gangrene.

The tourniquet is the chief temporary means, which in its primitive state was simply a band to go round the limb, with a pad placed immediately over the vessel, and the whole tightened by means of a bayonet or piece of stick.

To Petit we are indebted for the screw tourniquet ; and since his time there have been many modifications, nearly all with a view to stop the

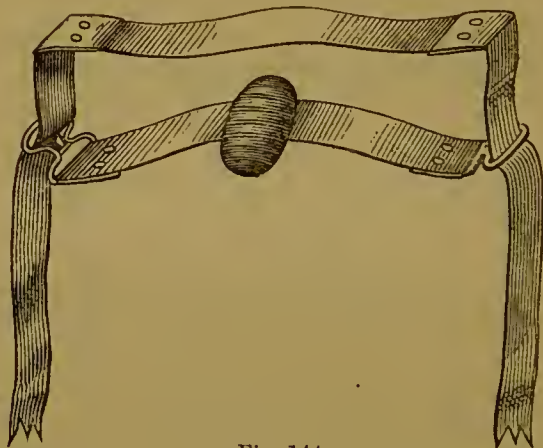


Fig. 144.

current of blood through the main artery of the limb, and at the same time to admit of a certain amount of circulation being carried on.

It was found that with wounded men having the old-fashioned twisted strap, or the more modern screw tourniquet, applied to a limb, and transported for any distance without surgical assistance, the tourniquet frequently shifted, or the man *lost the limb from gangrene*. To obviate this, and admit of a wounded man retaining the instrument for a considerable time, either during transport or until the services of a surgeon might be available, Dr. A. B. Mott, U.S.A., invented one with bands or hoops of iron or brass, which Mr. Hamilton describes as “a very ingenious field tourniquet (fig. 144), which is easily applied, and may be considered safe even in the hands of those who know nothing of the danger of ligating limbs too tightly, since

the compression is applied at only two points in the circumference of the limb."

Professor Esmarch, in his work on bandaging, describes a tourniquet for the field invented by Volckers, which, he considers, on the lower part of the upper arm, can be applied with much less danger than the usual circular tourniquet. Volckers found it was easy to make the pulse above the elbow disappear, by crossing the arm with a stick at the proper angle of the axis of the bone. This apparatus (fig. 145) can be made with two little round sticks of about 8 inches in length, one for the inside, and the other for the outside of the arm, which he keeps in position by means of straps. On the centre of the inner stick he attaches a pad, which is placed immediately over the artery, and by tightening the straps is brought to bear on the vessel.

For pressure on the femoral artery in the upper part of the thigh, Professor Esmarch gives an illustration of an apparatus which can be easily



Fig. 145.

constructed. A bandage is to be rolled on the middle of a stick at least a foot in length; then this bandage is to be placed against the artery, and tightened by means of a strap and strong buckle passed behind the limb and over each end of the stick; by this means continued pressure can be maintained (fig. 146).

An artery compress for field purposes is given in a Swiss manual, an account of which may be found useful. It is composed of a pad, bandage, round piece of strong leather, a short stick, and two strings. In order to apply it, the compress is laid on the limb with the pad next the artery, and the plate of leather on the opposite side. The two ends of the bandage are then tied over the plate, the stick pushed under it, and twisted till the bleeding ceases. The stick can then be kept in position by means of strings which fasten each end to the plate, and prevent it turning round (fig. 147).

Several ingenious modifications have been made of the ordinary screw tourniquet, whereby the strap is carried clear of the sides of the limb to

allow venous return. These have been effected by the addition of metal wings, over which the strap is carried.

Dr. John Hunter of the R.N. has designed three new forms of tourniquets which have the great advantage of allowing venous return.*

The expedients that may be employed for the permanent arrest of hæmorrhage are—pressure, ligature, torsion, acupressure, flexion, cauterization, application of cold, styptics, exposure to air, position.

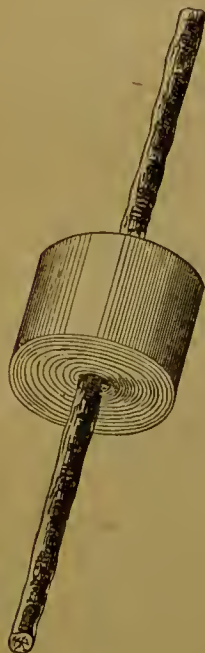


Fig. 146.

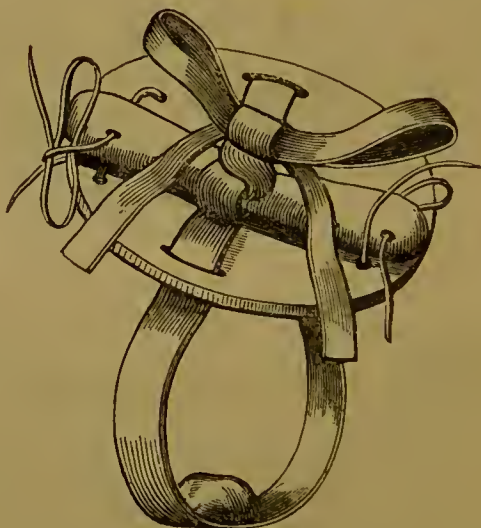


Fig. 147.

Torsion of arteries, though used in former times, fell into disuse, and was revived by Amussat and Velpeau. During the Franco-German War of 1870-71, Mr. MacCormac appears to have used it with marked success. He says: "I twisted the vessels in a very large number of cases of amputation for gun-shot wounds. I only remember a single instance of secondary hæmorrhage from a twisted vessel. It was a case of amputation through the knee-joint, in which acute pyæmia supervened. Torsion," he says, "is

* "Lancet," July 15, 1876.

more difficult and tedious in its application than a ligature. It is inapplicable when the arteries are diseased."

It is doubtful if it is a safe expedient in the field, especially if it be necessary to transport the sufferer immediately after its application.

Mr. MacCormac used unlimited torsion for the smaller arteries. For the large vessels lying loosely in unaltered sheaths, he considers it better to limit the length of artery twisted by grasping the vessel with a second forceps, otherwise the artery may be needlessly and dangerously disturbed in its relations to its sheath. He twists until he feels the internal coat giving way.

Mr. Spencer Wells has introduced a new kind of artery and torsion forceps, which very conveniently replace the old spring artery forceps of Liston, and the bull-dogs used for the temporary stoppage of bleeding vessels during operation, while they are the most readily applied of any of the varieties of torsion forceps met with.

The grasping and holding extremity is roughened by rather deeply-cut



Fig. 148.

transverse teeth (fig. 148), so that the bleeding vessel is forcibly compressed and its coats almost crushed together. This is alone sufficient to stop the bleeding without any torsion, especially if the instrument be left on the vessel for a minute or more.

Acupressure may be applied in several different ways, the object in all being to compress the mouth or bleeding orifice of the artery against tissue or bone.

Flexion may be used for hæmorrhage from the forearm, hand, lower leg, or foot, by placing a piece of lint or handkerchief rolled up in the bend of the elbow or under the knee; then flex the limb and fix it. In the event of a tourniquet not being available, this proceeding might be used with advantage.

Cauterisation is now seldom used; at the same time it may be found of use in hæmorrhage from the surface of irritable and indolent stumps, or in gun-shot wounds of the tongue. It is recommended that the iron which is

used for the purpose of canterisation should be at a black heat, being considered more effectual in that condition than at a red or white heat.

The application of ice or cold is nearly always attended by satisfactory results in wounds of very small vessels, favouring the coagulation of the blood. Mr. Hamilton is of opinion that *hot water* will accomplish this end more promptly than cold, and it is especially appropriate when the patient is feeble and exhausted by shock.

Styptics were much used in former days, but at present are not popular. They act by causing the blood to coagulate rapidly and firmly, but should only be used when there is oozing from parts where other applications cannot be conveniently made. Styptics are unfortunately most objectionable, as they act injuriously on the tissues to which they are applied, causing much pain and tendency to extensive sloughing or suppuration, and rendering healing by first intention impossible.

During the War of the Rebellion in America, the persulphate of iron in powder and perchloride in solution were largely employed for both primary and secondary hæmorrhage. The report of the Surgeon-General of the U.S. Army says that they caused great suffering to the patients, increased inflammatory phenomena, and converted tissues into blackened masses, interfering with ligaturing of vessels.

The styptics generally used are the perchloride of iron, matico, turpentine, gallic acid, alum, nitrate of silver, chloride of zinc, Ruspiui's styptic, and mineral acids.

Langenbeck has prescribed a solution of ergot in glycerine, to be used as a hypodermic injection in cases of hæmorrhage and in the treatment of aneurism: proportion—1 grain of ergotine to 6 minims of glycerine; two minims for an injection. This I tried in two cases of aneurism without any satisfactory result, but I have seen it successful in cases of epistaxis and hæmorrhage from an intercostal artery.

Snow has been recommended by Hasse of Nordhausen. He says that loose snow absorbs the effused blood better than a sponge; it acts also by the equal pressure which it produces and by constricting action of cold on the small vessels, and also as an anæsthetic on the nerves.

The administration of medicated astringents, such as tannin, acetate of lead, sulphuric acid, &c., has been recommended in cases of hæmorrhage, but I have never found the slightest benefit from them except in wounds of the lungs.

Wounds of Veins.—Unless from some large and deep-seated trunk, hæmorrhage from wounded veins is seldom dangerous.

If the wound of the chief vein of an extremity is complicated with wound of its artery, the case must be looked upon as most serious, being generally followed by gangrene of the limb. Such a case came under my notice during the Crimean War.

In ordinary cases of venous hæmorrhage, the bleeding may be restrained by pressure or elevation of the limb; but if there is any difficulty in checking it, acupressure or ligature may be applied. Hennen remarks on this subject: "When the great veins bleed, I have never hesitated about tying them, and it is most particularly necessary in debilitated subjects." During the Crimean War, the writer experienced several instances of troublesome bleeding from veins after amputation, delaying the closing of stumps, which he secured by means of fine ligatures, without any ill consequences.

LIGATURE OF ARTERIES.

THE instruments required for application of a ligature to an artery in its continuity are a scalpel, not too pointed, with a flat handle for pressing aside the tissues; a good-sized forceps; an aneurism needle; retractors; a ligature; needles and thread. In cutting down on an artery it may be only necessary to follow up a wound, which point should always be observed, the original wound being taken advantage of.

Mr. Erichsen gives such excellent instructions for cutting down on an artery, that they may be repeated here with advantage:—

"In making the first incision, the skin should be put on the stretch by the fingers of the left hand, or by those of an assistant. If the artery be superficial, or if there be parts of importance in its vicinity, the incision should not penetrate deeper than the skin. But if the vessel be deeply seated and no parts of importance intervene, it may be carried at once through the subcutaneous areolar tissue, until the fascia covering the artery is exposed. This must then be pinched up with the forceps, and opened by the edge of the scalpel laid horizontally. Through this opening a grooved director may then be passed, and the fascia incised on it, without risk to subjacent parts. The sheath of the vessel is now exposed by a little careful dissection; and the next step of the operation is one of great delicacy. It consists in exposing the artery and separating it from its accompanying vein. This is done by pinching up the sheath with the forceps and applying the knife horizontally. The artery having been exposed, the surgeon seizes one edge of the sheath with the forceps, and putting it on the stretch, generally separates the artery from its accompanying vein by tearing through the areolar connections with the end of the aneurism-needle, or with a director; being careful not to expose it to a greater extent than

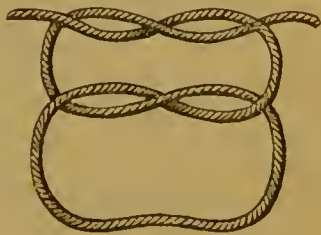


Fig. 149.

is absolutely necessary for the passage of the ligature. The ligature should be passed between the vein and the artery, care being taken only to include the latter, and especially not to transfix and include a portion of the vein. The artery should be tied tightly with a reef-knot, which does not slip (fig. 149).^{**}

The following table may assist in showing when the separation of ligatures from large arteries may be anticipated, at which period hæmorrhage is likely to occur:—

Common iliac, 18th to 25th day; external iliac, 15th to 22d day; femoral, 14th to 18th day; subclavian, 17th day; carotid, 20th day; brachial, 21st day; axillary, 22d day.

Ligature of the Common Carotid.—This operation may be performed above or below the omo-hyoid muscle.

Above the Omo-hyoid, or in its Superior Stage.—The first incision should commence a little beneath the angle of the lower jaw, and terminate on the side of the cricoid cartilage. This incision will divide the skin, platysma myoides, and cervical fascia, and expose the sheath of the vessels, with the descendens noni nerve lying in its front. The nerve is to be drawn outwards, and the sheath opened in a cautious manner. The needle is to be carried around the vessel from without inwards, taking care not to wound the jugular vein or include the pneumogastric nerve.*

Below the Omo-hyoid Muscle, or in its Inferior Stage.—"Make an incision through the integuments along the internal margin of the sterno-mastoid muscle for about 3 inches above the clavicle. A portion of the fascia, at the lower end of the incision, should next be raised in the forceps and divided in a horizontal direction. Through this opening a director should be introduced from below upwards in the line of the first incision, and the fascia slit upon it as far as necessary. The sterno-mastoid having been drawn outwards, and sterno-thyroid and sterno-hyoid inwards, the sheath of the vessel will be thus exposed. The ligature is to be passed round the artery, directing the needle from without inwards. On the front of the sheath will be found the internal branch of the descendens noni nerve."†

Ligature of External Carotid.—"Make an incision from angle of jaw to level of the thyroid cartilage, which should expose the digastric muscle. The artery may be tied above or below the crossing of the posterior belly of this muscle. The superior laryngeal nerve, which lies behind the origin of the vessel, must be avoided."

Ligature of the Lingual Artery.—Mr. C. F. Maunder recommends the following method, which is most practical: "To expose this vessel, turn the face to the opposite side, and make an incision $1\frac{1}{2}$ inches in length just above the greater cornu of the hyoid bone and parallel to it, the centre of

* "Anatomy of the Arteries of the Human Body," by J. H. Power, p. 65.

† *Ibid.*, p. 65.

the incision to correspond with the point of the greater corner, which should be made prominent by pressing upon the opposite side of the bone. Divide skin, superficial fascia, platysma, and deep fascia. The edges of the wound being separated, look for the posterior belly of the digastric muscle, passing downwards and forwards; and just below this, for the white cord of the hypoglossal nerve, also passing forwards, feel for the greater corner of the hyoid bone, and observe the upward course of the fibres of the hyoglossus muscle, and if its free border be visible, the artery will be found immediately behind it; should the free border not be visible, a few of its fibres divided transversely, will allow the artery to be seen and ligatured. The facial vein, if seen, should be held on one side.

Ligature of the Innominata and Subclavian Arteries.—Raise the shoulders of the patient, and allow the head to fall backwards, by which the artery will be drawn a little from within the chest. Let an incision be made over and down to the sterno-cleido-mastoideus muscle, the sternal origin of which, and nearly the whole of the clavicular origin, should be divided on a director carefully introduced below it, avoiding some small veins which run below and parallel with its origin. An incision is now or previously to be made, 2 inches in length, through the integuments along the inner edge of the muscle, which will admit of its being raised and turned upwards and outwards. Some cellular texture being torn through, the sterno-hyoideus muscle is brought into view, and should be divided on a director. The sterno-thyroideus is then to be cut through in a similar manner. A strong fascia and some cellular texture here cover the artery, having the large nerves running beneath it, the carotid being to the inside, the internal jugular vein to the outside. By following the carotid downwards, the finger will rest on the innominata and on the origin of the subclavian, and a ligature may be placed on either. If on the innominata, the aneurismal needle should be passed from without inwards, immediately below the bifurcation, close to the vessel. If on the subclavian, the ligature should be applied close to the vertebral artery, the needle being passed from below upwards, the greatest care being taken to avoid the recurrent nerve, which separates it from the par vagum at this part.*

The application of a ligature to the subclavian in the first part of its course is hardly a justifiable operation.

Ligature of the Subclavian Artery in its Third Stage.—This operation is as follows, the method being similar on both sides. The shoulders should be elevated. A good light should fall directly on the parts. An incision is to be made, commencing at the external margin of the sterno-mastoid muscle, immediately above the clavicle, and continued outwards for about 3 inches. Having divided the platysma-myoides and fascia, the lips of the wound should be separated, and any fibres of the trapezius which appear in the way must

* Guthrie's "Commentaries," p. 287.

be carefully divided on a director. The external jugular vein will now come into view, and should be drawn to the sternal end of the wound, but may be drawn to the acromial side if more convenient. The deep fascia must now be carefully scraped through, especially its connection with the scalenus anticus, and by tracing this muscle to its insertion with the first rib, the artery is at once reached, lying behind the insertion. Several arteries of large size will probably be found, and many veins. The supra-scapular artery and vein will be found behind the clavicle. The brachial plexus lies external to and behind the subclavian artery, the subclavian vein in front and below. The aneurism needle is to be passed round from below upwards, care being taken not to injure the vein or pleura, or include a nerve.

Ligature of the Axillary Artery.—This artery may be tied in its first and third stages. Delpech, however, has tied it in its second stage, by dividing the pectoralis minor muscle.

First Stage: The arm being abducted, a semi-lunar incision is to be made, with its convexity downwards, extending from $\frac{1}{2}$ an inch outside of the sternoclavicular articulation to very near the coracoid process, stopping just before it arrives at the edge of the deltoid—the cephalic vein being carefully avoided. This incision must include skin, fascia, and platysma, and the flap must be turned upwards. The clavicular portion of the pectoralis major muscle must be divided, the fibres of the pectoralis minor should be drawn to one side, when the artery will be felt pulsating, being only covered by the costocoracoid membrane, which must be carefully scratched through. In this step of the operation, the thoracic acromial artery may come into view, passing forward above the edge of the pectoralis minor muscle. The nerves should be pulled outwards, and the vein downwards and inwards, and the needle passed from within outwards. The passage of the ligature will be facilitated by bringing the arm down to the side of the body.

Third Stage, through base of the axilla: The arm being abducted and supinated, an incision should be made about $2\frac{1}{2}$ or 3 inches in length, through the integuments and fascia of the axilla. The coraco-brachialis muscle being ascertained, will form a good guide to the vessel, and by scraping through the cellular tissue the axillary vein will come into view. The needle should be passed round the artery from within outwards.

Ligature of the Brachial Artery.—This operation may be performed in any part of its course. The middle of the arm is the best point to choose. A line drawn from the middle of the axilla to the inner side of the biceps tendon at the bend of the elbow, indicates its course.

The arm being abducted and rotated outwards, an incision should be made about $2\frac{1}{2}$ inches long, on the internal margin of the biceps. “The skin, which is always thin, and the fascia, should be carefully divided, and the deep fascia exposed. This is next to be laid open, but with care, for the basilic vein lies immediately below it, on the inner side of the brachial

artery. The ulnar nerve will be found on the inner side of the vein, and the median in front of the artery, but there is no regularity in these relations; much care is consequently required in finding the vessel."

The surgeon should be careful not to open the sheath of the biceps muscle, and should remember to flex the forearm on the arm after the division of the deep fascia.

When in doubt as to the recognition of ulnar or median nerve,—the former in the middle of the arm will be found passing downwards and backwards.

Ligature of the Ulnar Artery at its Origin.—Mr. Guthrie recommends that, if the artery be wounded near its origin, "an incision should be made through the integuments and the aponeurosis of the biceps muscle; the pronator muscle being then exposed, it is to be drawn inwards and downwards, or towards the ulna, and the dissection continued until the median nerve is brought into view. The probe introduced through the original wound will lead to the artery, the pulsation of which will be felt and the bleeding seen."

To tie the ulnar artery at its lower end, make an incision at the interval between the flexor sublimis digitorum and flexor carpi ulnaris. The needle should be passed round the vessel from within outwards, taking care to avoid the nerve which lies to its ulnar side and venæ comites on either side.

Ligature of the Radial Artery.—This artery may be tied in the upper or the lower part of the forearm.

Operation in the Upper.—Here the artery lies in the interval between the supinator longus and the pronator radii teres. In a muscular arm, the edge of the former muscle is the best guide; in a fat one, the incision may be made in a line extending from the centre of the bend of the arm to the inner edge of the styloid process of the radius. The deep fascia must be exposed and opened, and the muscles relaxed and held aside.

Operation in the Lower.—Here the vessel is more superficial, lying in the groove between the flexor carpi radialis and supinator longus. An incision 2 inches in length, and parallel with these tendons, easily exposes the artery.

Ligature of Internal Iliac Artery.—"An incision should be made in the direction of a line extending from the umbilicus to midway between the spine of the pubis and the anterior superior spine of the ilium. This incision should commence at the outer edge of the rectus muscle, and terminate about an inch above Poupart's ligament, in order to avoid the spermatic cord. The different muscular layers composing the anterior wall of the abdomen being successively divided, the transversalis fascia should be cautiously scraped through, and the peritoneum exposed and pushed inwards. The fascia covering the vessels should also be torn with the nail, and then, by following the external iliac artery backwards, we arrive at the internal. In the angle between them lies the external iliac vein, which

should be carefully avoided, and the needle introduced from within outwards." *

Ligature of External Iliac.—"An incision must be made through the skin about 4 inches in length, but longer in proportion to the amount of subcutaneous fat and the depth of the pelvis, extending from a point 1 inch to the inside of the anterior superior spine of the ilium, to a point half an inch above the middle line of Poupart's ligament. It must be slightly curved, with its convexity looking outwards and downwards.

"The subcutaneous cellular tissue, and the tendon of the external oblique, may then be divided freely in the same line. Then at some one point or other, the internal oblique and transversalis muscles must be cautiously scraped through with the aid of the forceps, till the transversalis fascia is reached; they may then be freely divided by a probe-pointed bistoury (guarded by the finger pushed up below the muscles) to the required extent.

"The fascia transversalis must be carefully scratched through near the crest of the ilium, and thus the operator will be enabled to push the peritoneum inwards, and by the forefinger will easily recognise the pulsation of the artery.

"The ligature should be passed from the inner side to avoid including the vein." †

The common iliac artery may be arrived at for the purpose of including it in a ligature by the proceeding recommended for tying the internal iliac.

In applying a ligature to any of the iliac arteries, the operation will be greatly facilitated by placing a pillow under the pelvis of the patient, so as to make the abdominal muscles tense and throw forward the vessels.

Ligature of Gluteal Artery.—Draw a line from the posterior superior spinous process of the ilium downwards to the mid-point between the tuberosity of the ischium and the great trochanter; and then divide this line into three equal parts; the gluteal artery will be found emerging from the pelvis, at the junction of its upper and middle thirds.

The wound and flow of blood would form a guide.

Ligature of the Femoral Artery.—This artery may be tied immediately below Poupart's ligament, as recommended by Professor Porter, of Dublin (and practised successfully by his son, Surgeon G. H. Porter), in Scarpa's space, or middle of the thigh.

In the first position (Professor Porter's), it has been tied for a wound of the profunda femoral artery, and can be reached by making a transverse incision through the integuments, and so reaching the artery whilst enclosed within the funnel, and of course before it had given origin to the profunda.

Ligature of Femoral Artery in Scarpa's Space.—"The patient being placed on his back, and thigh rotated slightly outwards, an incision should

* "Anatomy of Arteries of the Human Body," by J. H. Power, p. 255.

† "Manual of Surgical Operations," by J. Bell, F.R.C.S., p. 9.

be made through the integuments, commencing about 2 inches beneath Poupart's ligament, and extending for about 3 inches in length over the course of the artery, which can be ascertained by its pulsation. The fat and superficial fascia should next be divided. The fascia lata is then divided to the same extent of the skin, the sartorius being drawn outward without opening its sheath. The sheath of the artery can now be opened, and the needle passed round the artery from within outwards."

Ligature of Femoral Artery in the Middle of the Thigh.—"In this position the artery may be reached by cutting the integuments on the internal or outer margin of the sartorius muscle. Mr. Hunter recommends the former proceeding. On drawing the muscle to one side, the sheath must be opened, and as the vein has altered its position, the needle should be passed from without inwards."

Ligature of the Popliteal Artery.—"In its superior third, this artery may be exposed by an incision on the external margin of the semi-membranosus muscle, closely applied to which is the popliteal nerve: the muscle being drawn inwards, and the nerve outwards, the vein will be found closely applied to the posterior or cutaneous surface of the artery, and projecting a little to its outside; great caution is therefore necessary in separating these vessels from one another, and the needle should be passed from without inwards."

"The vessel may be secured in its inferior third by a vertical incision between the heads of the gastrocnemius muscle. The posterior saphenous nerve and vein being drawn out of the way, the popliteal nerve will be brought into view. Deeper, and more externally, is the vein; and still deeper, and projecting on the outside of the vein, is the artery. The nerve may be drawn to the inside, and the vein either internally or externally, as may be found most convenient. The needle is to be introduced with its convexity to the vein."

Ligature of Posterior Tibial Artery.—"The course of the artery corresponds with a line drawn from the middle of the popliteal space to the middle of the space between the heel and inner ankle. To tie the vessel in the upper part of the leg, an incision 4 inches long, half in the upper and half in the middle third of the leg, should be made through the skin and fascia. This incision should be about 1 inch from the tibia, or a little more if the patient is stout."

"The deep fascia is next to be divided, which will expose the edge of the gastrocnemius, which is to be drawn aside, when the solens will come into view, the fibres of which are to be severed to the extent of the first incision, and until the fascia covering its anterior surface is seen; this is to be perforated and divided, when the vessel will be found lying on the tibialis posticus, surrounded by the fascia which intervenes between the superficial and deep layer of muscle." *

* "Manual of Surgical Operations," by J. Bell, p. 2.

To tie the Posterior Tibial in the Middle of the Leg.—"An incision 3 inches long is to be made, half in the middle third and half in the lower, and midway between the inner edge of the tibia and the inner border of tendo-Achillis. After dividing the fascia, the artery will be found surrounded by fat along the inner edge of the flexor longus digitorum, accompanied by two veins, the nerve to the outer side."

To tie the Posterior Tibial at the Ankle.—"It is to be exposed by a curved incision $2\frac{1}{2}$ inches long, in the groove, midway between the hinder edge of the internal malleolus and the extremity of the heel."

Ligature of Anterior Tibial.—"A line drawn downwards from the head of the fibula to the base of the great toe, or, as some recommend, from the prominent portion of the external condyle of the tibia anterior to the superior tibio-fibular articulation, will correspond with the position of the artery and the tendinous intersection between the tibialis anticus and the extensor digitorum communis muscle."

Ligature of the Dorsalis Pedis Artery.—"At the instep this artery may be exposed by an incision between the tendons of the extensor digitorum communis and extensor pollicis longus."

Ligature of Peroneal Artery.—"It is exposed by an incision, extending from midpoint between the tendo-Achillis and the external malleolus, 4 inches upwards and outwards towards the fibula. The fibres of the flexor pollicis longus should be detached from the fibula as far as necessary, and drawn to one side, when the vessel will be found lying on the interosseous ligament close to the fibula."

Ligature of the Aorta.—"A straight incision in the linea alba, just avoiding the umbilicus by a curve, and dividing the peritoneum, allows the intestines to be pushed aside, and the aorta exposed still covered by the peritoneum, as it lies in front of the lumbar vertebræ. The peritoneum must again be divided very cautiously at the point selected, and the aortic plexus of nerves carefully dissected off, in order that they may not be interfered with by the ligature. The ligature should then be passed round, tied, cut short, and the wound accurately sewed up."*

MORTIFICATION, OR GANGRENE.

THIS disease may have to engage the attention of the army surgeon as a result to which all gun-shot wounds are more or less liable, from injury or ligature of the main artery of a limb, or from exposure to cold, or from privation, unwholesome food, scurvy, or other blood diseases. It may also be the result of inordinate inflammation: and may be rapidly diffused or suddenly developed.

* "Manual of Surgical Operations," by J. Bell, p. 2.

In traumatic gangrene, or that induced by local causes, the parts may be so injured that they are killed outright, or cannot recover themselves, such as cases of severe bruises, laceration, wound of the main artery or vein of a limb interfering with the circulation, which frequently happens in gun-shot fractures when the splinters of bone or missile wound the artery, or in punctured or incised wounds of a large vessel allowing of extravasation. It has also happened from a bandage being applied too tightly.

In those cases occasioned by severe lacerations or bruises (*local gangrene*), only the parts originally injured die, and there is but little necessity for surgical interference. The local application of tepid water, or poultices with charcoal, or some fermenting agent, to which an antiseptic may be added, will be found comforting, and hasten the separation of the dead portions. The strength of the patient may be maintained by wine, nutritious diet, tonics of mineral acids, or quinine, and the patient's system, as far as possible, protected from poisoning by absorption of the decomposed animal substances which are in close connection with veins and absorbents.

The use of opium in these cases has a highly beneficial result, given in small and frequently repeated doses, or in full doses where there is great restlessness at night.

In gangrene resulting from a wound of the main vessels, or compound fracture, or any local cause, such as obstruction of the artery (*distant gangrene*), the rule laid down by older surgeons was to wait for the line of separation before the parts were removed by amputation. This practice has, however, been set aside for some years.

Larrey established the rule that when mortification is the result of mechanical causes, and puts the patient's life in danger, we must not wait until the disorder has ceased to spread. This rule is still in force, and has the sanction of the highest authorities.

Mr. Guthrie gives two or three examples of the practice in extreme cases : "A soldier is wounded by a musket-ball at the upper part of the middle third of the thigh, and on the third day the great toe has become of a tallowy colour, and has lost its life : what is to be done ? Wait,—with the hope that the mortification will not extend.

"Suppose that the approaching mortification has not been observed until it has invaded the instep ; what is to be done ? Wait,—provided there are no constitutional symptoms ; but if they should be present, or the discoloration of the skin should appear to spread, amputation should be performed forthwith, for such cases rarely escape with life if it be not done. Where in such a case should the amputation be performed ? I formerly recommended that it should be done at the part injured in the thigh. I do not now advise it to be done there at an early period, when the foot only is implicated ; but immediately below the knee, at that part where, if mortification ever stops, and the patient survives, it is usually arrested ; for the knee

is by this means saved, and the great danger attendant on an amputation at the upper third of the thigh is avoided. When from some cause or other amputation has not been performed, and the mortification has stopped below the knee, it is recommended to amputate above the knee after a line of separation has formed between the dead and the living. This should not be done. The amputation should be performed in the dead parts, just below the line of separation, in the most cautious and gentle manner possible; the mortified parts which remain being allowed to separate by the efforts of nature." In mortification of the fingers, hand, or forearm, from a wound of the axillary artery, the principle of the treatment should be the same.

Mr. C. H. Moore, in referring to the obstruction of the principal artery of a limb in which gangrene should come on, says: The treatment will depend upon the rate of its progress and the state of the patient's system. No delay in amputation should be permitted when the mortification spreads rapidly, with swelling of the limb and decreasing depression of strength.

It may be permitted to wait for the formation of the line of demarcation, when the gangrene commences at the digits, and ascends slowly for days or weeks.

A limb affected with rapidly spreading gangrene should be amputated above the affected parts, and, as a rule, at the level of the obliteration of the artery. When, however, the femoral artery and vein have been divided by a mere cut as high as Poupart's ligament, and mortification of the foot supervenes, the limb may be removed at or a little below the knee.

Legouest, in remarking on numerous local and constitutional treatments which have been employed for gangrene without benefit, says that amputation is the only means of opposing it, and yet that it is not always efficacious; he has obtained success in amputating at the line between the dead and the living tissue where the parts are already infiltrated, but adds: "It is obviously better to amputate in the healthy parts, where one can choose the place."

The result of amputation for traumatic gangrene is on the whole unfavourable, the disease frequently recurring in the stump (*recurrent gangrene*), or the patient sinking from exhaustion; and in those cases where the tissues are already infiltrated or disorganised, the prospects from amputation are still more unfavourable.

Gangrene from Frost-bite and Severe Burns.—Erischen lays down the principle that there are two exceptions to the rule of amputating in traumatic gangrene before the occurrence of the line of demarcation; viz., gangrene from frost-bite, and that from severe burns. During the severe winter of 1854, when the allied armies were before Sevastopol, the writer witnessed several cases of gangrene of the feet from exposure, both in camp and in the trenches.

Those who were attacked by the disease in the trenches had their feet first

wet by the mud and constant rain, when frost suddenly set in, and in consequence of the impossibility of moving about, the circulation became arrested.

Those who were attacked in camp found their feet numb and helpless on rising in the morning, having lain down on damp ground without removing their wet socks or boots, the result frequently being loss of both feet. The treatment adopted was to relieve the fever of reaction, support the constitution, and allow the dead portions to separate from the living, assisting them by the means already described in gangrene from laceration or bruises, and subsequently detaching with great care such parts as were disorganised. This gangrene may, to a certain extent, have been brought about by a scorbutic taint, as the ulcers which remained were most difficult to heal.

In idiopathic gangrene, or that induced by constitutional causes, the rule is never to amputate until the line of separation has formed, and then to wait until the parts have ulcerated so deeply that there is no prospect of its extending further. During the process of separation the patient's health should be improved and prepared for the operation of amputation, which in general will consist in cutting through osseous, ligamentous, or tendinous structures. It may, however, be necessary to form a regular stump by amputation higher up or through the stump already formed, the flaps being designed according to circumstances.

Bed sores (a form of gangrene from pressure which but too frequently comes under the notice of the army surgeon), arise from patients being obliged to lie for lengthened periods in the same position, after having undergone operations; or in the treatment of fractures of the lower extremities, probably without proper bedding, cleanliness, nursing, or fresh air; or, in patients already debilitated from exposure and want of proper nourishment; and from injury to the spinal cord and other parts of the nervous system.

These sores generally appear on the sacrum, the trochanters, elbows, shoulders, heels, and back of the head.

The surgeon should ever be on the watch for them, as, in very weak subjects, they give but little warning of their approach or presence.

When there is a probability of long confinement, and the case is likely to be attended with constant decubitus, every precaution should be adopted, such as keeping the parts dry, the bedclothes smooth, and pillows arranged from time to time so as to prevent pressure on any particular spot.

Water and air beds may be used with great advantage, but in warm climates they are heating.

The skin may be hardened by the application of brandy, rectified spirits, solution of alum, tannin, tincture of iodine, collodion, or of bi-chloride of mercury composed of two grains to one ounce of spirits of wine.

Sir William Fergusson recommends that the parts be defended with soap plaster, spread on felt; others recommend its being spread on isinglass

plaster. The writer has a strong objection to plasters as preventives for bed sores, because they are liable to wrinkle, to cause irritation, and to prevent the condition of the parts being seen.

When bed sores do occur, removal of pressure must be carried out by some means, which, on service in the field, requires ingenuity, as the usual mechanical contrivances found in permanent hospitals may not be present.

A sling for the more convenient treatment of bed sores has been designed by the author, which he used with advantage in cases where the sacrum and nates were severely implicated, and which may be applied in camp or in permanent hospitals.

The sling consists of a strip of West of England canvas, 18×24 inches. At either end it is stitched on two pieces of strong wood about the diameter of the common office-ruler, which keeps the canvas expanded when under the patient, and forms a means of fastening the stays, which are spliced together and attached to 3-inch blocks. These blocks have ropes passing through them and through blocks of the same size attached to poles or uprights (fig.

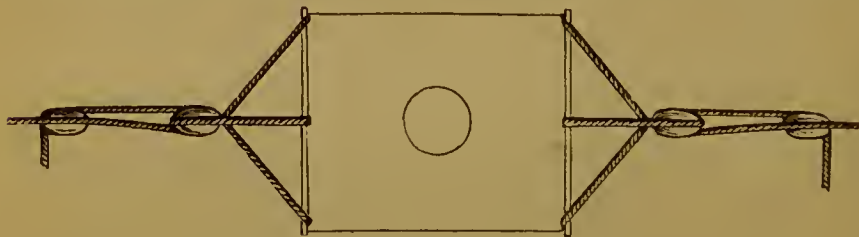


Fig. 150.

150), by which means the sling can be raised or lowered. A piece of canvas, round in shape, and 4 inches in diameter, is removed from the centre of the sling, through which the sores can be dressed or cleaned. In applying the sling, it is necessary to place a mattress doubled at one end under the patient's shoulders, the thin end extending to the loins. A pillow should be placed under the knees, and, except for dressing the sores, the patient should not be raised more than 1 inch off the bed.

For local application, numerous remedies have been recommended. Cleanliness should be the first consideration, and the removal of sloughs if any exist; after which soft poultices may be applied, which act as cushions as well, besides having other good qualities; these may be composed of fermenting materials, or sprinkled with charcoal.

Equal parts of castor oil and balsam copaiba may be applied; this, in the hands of the writer, has always been attended with success.

Balsam of Peru, either pure or diluted with the yolk of egg, spread on

lint, is useful. Salicylic acid ointment has been found useful spread on very thin linen.

Warm astringent applications, such as catechu, myrrh, iodine, resin, have been spoken highly of.

The health of the patient must be carefully attended to, as, without improvement in it, the sores will not heal.

TETANUS.

THERE are two varieties of this disease—the idiopathic and traumatic: the former originating from cold or damp, particularly if the body has been previously exposed to heat and perspiring; and the latter from some kind of injury, in which exposure to cold may predispose to its attack, as occurred after the battle of Ferozepore and Chillianwallah, when the wounded were exposed during the cold nights, after very hard work during the day in a burning sun. It also occurred in Egypt under the same circumstances, as mentioned by Larrey; and after the battle of Ticonderogo, when the wounded were exposed the whole night after the action, in open boats, upon Lake George.

The symptoms in both are exactly the same, but they may vary in degree.

The experience of army surgeons is, that tetanus may supervene on every description and in every stage of wounds, from the slightest to the most formidable, in the healthy and sloughing, the incised and lacerated, the most simple and the most complicated; in all constitutions; in the strong and robust, and in the feeble and debilitated. It is, however, more apt to occur in debilitated subjects when the nervous system is lowered. It is more common in hot than cold climates. It occurs in all states of the atmosphere, but is most common during sudden changes of the weather.

Missiles and also pieces of cloth that have not been extracted, appear to exercise some influence on the development of the disease.

Punctured wounds appear more liable to be followed by tetanus; and wounds of the extremities more than wounds in the head, breast, or neck.

Hennen considers that exposure to different temperatures appears equally to predispose to it, and that the various forms of the disease are produced indiscriminately by similar causes.

Hamilton divides the causes of traumatic tetanus into predisposing and exciting; the predisposing being mental depression, climacteric influences, such as excessive heat, sudden vicissitudes of weather, and especially a rapid change from hot to cold and damp weather—it is more frequent in spring and autumn than in summer or winter—exposure of a portion of the body to cold draughts of air, an irritable temperament, physical exhaustion, disorder of the stomach and bowels, or a scorbutic taint.

The exciting causes are wounds, especially compound fractures, in which spiculæ of bone press upon nerve trunks; wounds accompanied with unhealthy suppuration, gangrenous sores, or those which from neglect are not kept properly cleaned; laceration, contusion, partial division or ligature of a nerve.

Professor W. C. Maclean is of opinion that excessive irritation of gun-shot wounds, when they are in an inflamed condition before suppurative action has commenced, may give rise to tetanus; * jolting and disturbance of wounds by ill-constructed conveyances, has been given as a cause.

In temperate climates the disease seldom supervenes before the fourth or fifth day. In hot climates it may appear sooner; but it may take place at any period after the infliction of the injury, even after the wound has cicatrised.

Tetanus may be acute or chronic; the former proving in general rapidly fatal, and the latter continuing for a considerable period. The further prolongation of the disease, the better are the prospects of recovery.

The disease is generally ushered in by a disturbed state of the digestive organs, with a feeling of malaise, a sense of weakness, and general depression; stiffness or soreness about the jaw, face, and neck; inability to swallow food or drink. As the disease advances, there is pain in the pit of the stomach, spasms of the voluntary muscles, the countenance assumes an aged and agonised expression, the angles of the mouth being drawn up (*risus sardonius*). Cramps and pains will attack the muscles of the legs; difficulty of breathing will set in with a loud sobbing from spasms of the diaphragm. The skin will be hot, the pulse quick, and perspiration profuse, with pungent smell. The mind in all probability will remain clear, but the sleeplessness will cause much distress.

The muscles of the trunk become affected, the body being sometimes bent back forming an arch (*opisthotonos*), or to one side; or the body may be straight, stiff, and rigid, with the belly drawn in and chest expanded; or the body may be arched forward (*emprosthotonos*). There may be constipation, but the sufferer will have perfect control of the bladder. The voice will be weak from spasmodic contraction of the muscles of the chest and neck.

The temperature generally becomes very high, particularly immediately before death, which occurs from exhaustion.

The sufferer may have short intervals of relief, the spasm being again induced by a slight current of air passing over the body, by taking food or fluids, or by shifting position or bed-clothes.

It has long been a subject of intense interest and consideration to discover what will relieve an unfortunate sufferer from this terrible disease, and offer some hope of recovery.

Older surgeons appear to have been helpless even as regards affording


* Longmore "On Gun-shot Injuries," 1877, p. 248.

relief; and in the present day it is generally admitted that, though cures may be established in chronic cases, the acute disease always proves fatal.

Hennen remarks: "Happy should I be could I afford anything satisfactory on this dreadful complaint; but, in truth, my observations have tended more to show me what I could *not* trust to, than what I could place the smallest reliance on, when the disease was fully formed;" and further on he says, "I have never been fortunate enough to cure a case of Acute Symptomatic Tetanus; in some instances of the Chronic species I have effected or witnessed relief." Compare these remarks, written fifty-five years ago, with what Mr. Erichsen now says: "Nothing can be more unsatisfactory than the treatment of the acute form of traumatic tetanus. In it all medicines are useless as curative agents; but though medicines are of no avail as means of cure, they may act as palliatives and afford relief to the patient."

The line of treatment must be local and constitutional, the former being with a view to removal of the irritation producing the disease. For this purpose, if there is a wound, it should be most carefully cleansed, and all extraneous substances, such as pieces of clothing, bullets, and splinters of bone, should be removed. If matter is pent up, it must be evacuated; and if the wound is inflamed, an endeavour should be made to bring it to a healthy state.

Section of Nerve.—The tetanic symptoms having been induced by puncture or laceration of a nerve, Larrey recommended that it, the trunk, should be divided, and was successful in the treatment. This expedient has also been adopted by others, and with satisfactory results.

Mr. Liston recommends cutting down on the bone, with a -shaped incision, above the seat of injury, cutting it off completely from the influence of the nerves.

Professor Fayrer, of Calcutta, mentions a case of tetanus caused by a wound of the hand, and relieved by section of the median nerve.

Excision of a portion of the injured nerve has been suggested.

Nerve stretching has been advocated by Mr. Milner, M. Verneuil and Mr. Callender. The nerve is to be exposed and stretched when freed from its surroundings.

Amputation of the injured limb has been adopted, the better to remove all possible sources of irritation; this measure is not now advocated.

The remedies recommended for constitutional treatment are numerous, surgeons having tried them from time to time, probably affording relief in some cases, and being utterly worthless in others. The following may be mentioned: opium, blood-letting, cold and warm baths, cold affusion, hot-air baths, ice to the spine, bromide of ammonium, galvanism, bark, wine, spirits, mercury, purgatives, foxglove, tobacco, Indian hemp, musk, Prussic

acid, iron, belladonna, turpentine, strychnine, woorali, ether, chloroform, chloral, Calabar bean. Hydrate of chloral has been used by Dr. Macnamara of Calcutta, and Dr. Murray of Dominica advocates its use in combination with opium.

A case of tetanus having occurred, the bowels should first be relieved by a large enema with turpentine, after which perfect quietness, in a darkened room free from noise or currents of air, must be insisted upon, being the best means of preventing the approach of spasm. The use of the ice-bag along the spine, as recommended by Todd, has afforded relief in allaying the spinal irritation, but is a great depressant. Chloroform has been extensively used, but without any permanent benefit. Hamilton remarks on this remedy, that "it has been tried very largely during the past few years, and, so far as we can learn, almost universally by our army surgeons, but not with a success which in our judgment would warrant its continuance, or, to say the least, its substitution for opium or morphine." After enumerating the various remedies proposed, he goes on to say: "In our opinion, but few of these remedies are entitled to any special confidence; by far the largest mass of testimony having accumulated in favour of nutritious food, tonics, stimulants, and opiates, the latter of which, if employed at all, must be given in the most liberal and persevering manner; in some cases both by the mouth and by the rectum, or by the endemic method."

With regard to sedative and antispasmodic agents, Erichsen considers that they are of no use whatever in acute traumatic tetanus. "I have," he says, "seen many drugs of this kind employed without producing any effect in lessening the violence of the convulsion. In most cases, however, the inhalation of chloroform, or the administration of chloral, materially lessens their severity, and gives the patient at least temporary ease."

Sir W. Fergusson observes: "The free use of purgatives by the mouth and as clysters, and then the use of opiates and antispasmodics, are the means which I should be the most inclined to at first; and by narrowly watching the symptoms, some hint might be gleaned as to whether these should be persisted in or abandoned. In such cases as I have seen since the introduction of anæsthesia, that influence has seemed to me the most powerful for temporary benefit. I have never known chloroform fail to take off the spasm in the earlier stages of the disease."

The Calabar bean has been used of late years with some success, but, like all other medicines, it has failed in many hands. It is a great depressant, and with it large quantities of stimulants should be given, as well as beef-tea, as long as the patient will take them, or by enemata. The bean should be given frequently, and until the pupil is completely contracted. Dose, 1 to 3 grains; extract, $\frac{1}{4}$ to $\frac{1}{2}$ grain.

Surgeon-General Gordon reports that, during the siege of Paris, M. Demarquay saved several individuals who had manifested the early

symptoms in the form of trismus, by means of very hot air-baths, followed by the injection of morphine under the skin.

The results in the developed cases seem to have been unfavourable.

Mr. Wagstaff of St. Thomas's Hospital records a successful case treated by profuse sweating, induced by the hot-air bath persevered in for twenty-three days, morning and evening.

The inhalation of nitrate of amyl has been recommended by Dr. W. S. Forbes of Philadelphia ; 3 to 5 drops may be inhaled.

Professor Fayrer records two cases of traumatic tetanus treated and cured by opium smoking and internal administration of chloroform and hemp. Both patients were Hindoos. The average quantity of opium-goolie smoked daily by one patient was 84 grains. The chloroform and hemp were administered according to the following prescription :—

R. Chloroform, ℥x.

Ext. of hemp, gr. i.

Mucilage, ʒi.

Camphor Mixt. ʒss. Every six hours.*

Stimulants and nourishment appear to give more prospects of success than any other means, and with the use of chloroform to lessen the spasms, perfect rest, quietness, and freedom from currents of air, the sufferer may withstand the exhaustion in the chronic form of the disease. On this line of treatment Sir T. Watson remarks : " In all cases, there being no special indication to the contrary, I should be more disposed to administer wine in large quantities and nutriment than any particular drug." These remarks are most significant and important.

HOSPITAL GANGRENE.

"PUTRID ULCER," "Phagedæna Gangrenosa," "Sloughing Ulcer," "Pourriture d'Hôpital," "Gangræna Contagiosa," "Hospital Sore."

Forms of Hospital Gangrene.—Delpsch describes three forms, the ulcerative, the pulpous, and the gangrenous. M. Legouest has added two other forms, viz., the gelatinous, and the gelatinous hæmorrhagic.

Hennen attributes hospital gangrene to bad air, want of cleanliness and ventilation, also to intemperance. Guthrie says, "It originates only in badly-ventilated hospitals, crowded with wounded men, among and around whom cleanliness has not been too well observed."

Legouest, after pointing out the usual unsanitary conditions which are liable to promote this disease, remarks : "Yet we have observed it in the most healthy hospitals, in well-ventilated corridors, in churches, in barracks

* Fayrer's "Clinical Surgery," p. 531.

and even under canvas, and that under the most strict hygienic observances. Can it be averted, while large numbers of wounded are collected together in the same building, and it may be propagated through the atmosphere, as an epidemic, or by contagion, by sponges, charpie, and dressings?"

The experience of Hamilton appears to coincide very much with that of Legouest, that notwithstanding the most careful sanitary arrangements and healthy position, protracted epidemics of the disease have been inaugurated. He gives as examples the epidemics which occurred at De Camp and McDougall General Hospitals during the summer of 1863.

Taylor, who had great experience of the disease in India, was unable to determine satisfactorily to himself whether it be a local or constitutional affection. "I am inclined," he says, "to place it in the former category; and there is no doubt whatever that the essential means of treatment are local."

Blackadder is of opinion that at first it is a purely local affection, and that the constitutional symptoms do not make their appearance before the third, fourth, or, sometimes, not till the eleventh day.

Hennen describes the disease, as it occurred at Bilbao, in the following words:—"Let us suppose that our wounded have all been going on well for several days, when suddenly one of our most promising patients complains of severe pain in the head and eyes, a particular tightness about the forehead, want of sleep, and loss of appetite, and that these feelings are accompanied with quickness of pulse and other symptoms of fever; his wound, which had been healthy and granulating, at once becomes tumid, dry, and painful, losing its florid colour, and assuming a dry and glassy coat. This is a description of the first stage of our Bilbao hospital gangrene; and if a brisk emetic was now exhibited, a surgeon not aware of the disease that was about to form, would be astonished at the amelioration of the sore, and the unusual quantity of bile and indigested matter evacuated by vomiting. If, however, this incipient stage was overlooked, the febrile symptoms very soon became aggravated; the skin around the sore assumed a highly florid colour, which shortly became darker, then bluish, and at last black, with a disposition to vesicate; while the rest of the limb betrayed a tendency to œdema. All these threatening appearances occurred within twenty-four hours; and at this period also the wound, particularly if it was situated on a muscular part of the thigh, buttock, or calf of the leg, whatever might have been its original shape, soon assumed the Circular Form. The sore now acquired hard, prominent, ragged edges, giving it a cup-like appearance, with particular points of the lip of a dirty-yellow hue, while the bottom of the cavity was lined with a flabby blackish slough.

"This rapid progress and circular form of the ulcer were highly characteristic of hospital gangrene, and obtained almost universally, in every wound infected with it, wherever situated.

"The gangrene still advancing, fresh sloughs were rapidly formed, the increasing cup-like cavity was filled up and overtopped by them, and the erysipelatous livor and vesication of the surrounding skin gained ground, while chains of inflamed lymphatics could be traced from the sores to the adjoining glands, these exciting inflammation and suppuration, which often furnished a new nidus for gangrene. The face of the sufferer assumed a ghastly, anxious appearance; his eyes became haggard, and deeply tinged with bile, his tongue loaded with a brown or blackish fur, his appetite entirely failed him, and his pulse was considerably sunk in strength, and proportionally accelerated. In this stage the weakness and irritability of the patient was such, that the slightest change of posture, or the most delicate examination of the sore, put him to torture, increased by his inability to steady the limb, which, if moved at all from the bed, was seized with tremors and spasmodic twitches."

Mr. Hennen speaks of the torture of this disease as something terrible: "Men," he says, "who had borne amputation without a groan, shrunk at the washing of their sores, and shuddered at the sight of a dead comrade, or even on hearing the report of his death, instantly predicting their own dissolution, and sinking into sullen despair. The third and last stage was now fast approaching. The surface of the sore was constantly covered with a bloody oozing, and, on lifting up the edge of the flabby slough, the probe was tinged with dark-coloured grumous blood, with which also its track became immediately filled; repeated and copious venous bleedings now came on, which rapidly sunk the patient; the sloughs, whether falling off spontaneously, or detached by art, were quickly succeeded by others, and discovered on their removal small thickly studded specks of arterial blood. At length an artery sprung, which, in the attempt to secure it, most probably burst under the ligature. Incessant retchings soon came on, and, with coma, involuntary stools, and hiccup, closed the scene. Often, however, the patient survived this acute state of the disease, and sunk under severe irritation, absorption of putrid matter, and extensive loss of substance, without any other symptoms than those of hectic fever, arising from other sources."

The muscles may become extensively exposed or destroyed, leaving a cavity with tendons, vessels, and nerves stretched across from side to side. The bones sometimes become denuded of periosteum, or are attacked with the disease.

Blackadder, who records the disease as it appeared in himself, says it commenced with local symptoms. He wounded himself accidentally with a scalpel. In the course of about sixty hours the wound became inflamed, and he was occasionally attracted to it by a smart, stinging sensation, which ultimately extended a considerable way up the arm. On the fourth day the inflammation had increased, and the stinging sensation was almost constant;

headaches, nausea, and general indisposition followed, with frequent chills, which increased very much towards evening, but which, with other symptoms, were considerably relieved by the use of neutral salts, the pediluvium, and warm diluents. A vesicle, having a depression in its centre, and having a watery fluid of a livid colour, was now forming upon a hard and elevated base; the surrounding integuments became tumified, of an anserine appearance, and extremely sensitive to the touch; at about the distance of the fourth of an inch from the base of the tumour, a distinct areola of a bluish-red colour made its appearance, and remained visible for several days. At this period circumstances rendered it necessary for him to be exposed to wet, to undergo considerable fatigue, and immediately afterwards to travel to a considerable distance. The inflammation, however, gradually subsided, but the stinging, accompanied by the burning sensation, still continued; and the sore had no disposition to heal, yet it did not enlarge externally, but was disposed to burrow under the integuments.

Mr. Taylor, late of H. B. M. 29th Regiment, experienced an epidemic at Ferozepore, in India. He remarks: "First, I could tell, by the peculiar dark florid countenance of the patient, that his wound had taken on the gangrenous affection; yet I cannot say that there was in these cases any marked inflammatory fever. In many cases the disease seemed purely local; but in the great majority there was certainly much feverish constitutional disturbance accompanying the local affection, and often preceding it."

There appears to be some difference of opinion among surgeons as to whether the disease has a local or constitutional origin. In some epidemics it set in with febrile symptoms and general constitutional disturbance, and in others the symptoms were entirely local, or very slight constitutional disturbance. There is no doubt as to its highly contagious and infectious character, that it is capable of being transmitted by nurses, clothing, dressings, instruments, sponges, and atmosphere; that it attacks wounds in every stage and condition; that it can be inoculated; that it is generally caused by overcrowding of wounded, bad ventilation, want of cleanliness, privation, intemperance, and previous exposure, but that there are occasions when it occurs in the form of an epidemic, notwithstanding the most rigid and careful sanitary regulations; that it appears in all climates, in all seasons and weather, the wet and moist or very cold being most favourable to its production; and, finally, that there may be predisposing causes, such as patients having a scorbutic taint, an enfeebled constitution, or a nervous system depressed by the effects of a severe operation, or administration of chloroform.

The symptoms in every feature of the disease have been so well described by Hennen, Blackadder, and Taylor, in the foregoing remarks, that it is scarcely necessary to repeat them again.

With regard to the treatment of this formidable disease, no specific has as yet been laid down for its cure, but each medical officer who has had the misfortune to meet with it has recommended such treatment as he found most successful.

The first consideration of the surgeon will be to try and prevent a further spread of the disease, by removal of the infected patient from among the other wounded, and by prophylactic measures, such as the use of disinfectants with all suppurating wounds, plenty of fresh air, strict sanitary arrangements in and about the hospital buildings, destruction by fire of all dressings, the total disuse of sponges, cleanliness among the patients, attendants, clothing, and bedding, evacuation of infected buildings, and fumigation of them.

The sufferer will have to be considered with respect to local and constitutional symptoms. For the former, numerous applications have been tried and recommended, which, as some writers remark, may agree with the ulcer for a day or two, then become inert or hurtful. The following are some of these :—Strong mineral acids, arsenic, nitrate of silver, turpentine, creasote, permanganate of potash, camphor, antiseptics, iodine, perchloride and sulphate of iron, carbolic acid, irrigation, leeches ; also the bromides and actual cautery, as recommended by Pouteau, Delpech, and Dupuytren. Of late years, bromine and the actual cautery have afforded the most satisfactory results. Burnt alum has also been recommended.

Mr. A. E. Baker, of Dublin, who had some experience of the disease during the Franco-German War of 1870–71, while aiding the sick and wounded, says that the more active treatment employed with a view to arrest the ravages of the disease, consisted in the application of various caustics ; thus liquor ferri sesquichloridi, chloride of zinc, acid nitrate of mercury, nitric acid, and the actual cautery, were all made use of ; none of them, however, seemed to be of any service except the last ; indeed, after the application of the chloride of zinc, the extent of the wounded surface seemed to increase more rapidly than before.

In the application of the actual cautery, he considers that, if only properly applied, it would always put a stop to the morbid action ; but to bring this about, care had to be taken to let the effect of the hot irons extend beyond the tissues already the seat of the affection, and into the healthy structures further off.

Legouest considers the actual cautery most useful in severe cases of hospital gangrene. "Unfortunately," he says, "its use is not always practicable. It requires a steady hand and great determination to place the iron in the neighbourhood of the large vessels, nerves, tendons, articulating surfaces, which sometimes render its application dangerous."

Professor von Nussbaum of Munich testifies as to the great benefit to be derived from practising Lister's antiseptic dressings in the treatment of

this affection, and also to its efficiency as a prophylactic against the disease.

Lemon juice applied on pads of charpie two or three times a day has been found beneficial by Chenu and Bongard.

Hamilton, after mentioning the usual local remedies, remarks that from his own experience he is convinced of the superiority of bromine over any other preparations, as a local application. Dr. M. Goldsmith, U.S.V., introduced this agent; and, for its application, Hamilton gives the following useful and practical hints:—

1. The use of an anæsthetic, if the operation promises to be a long and tedious one, Mr. Hamilton objects to, on account of its depressing influence as a predisposing cause of the disease.

2. The wound should be thoroughly cleansed with warm water and soap, and freed from all dead and gangrenous tissue by means of scalpel or scissors, aided by the forceps. The healthy tissue should be denuded as far as possible.

3. The surface to be treated should be thoroughly freed from moisture, the pouches and recesses not being omitted.

4. If the pure bromine be used, a small glass pipette should be introduced into the bottle containing the liquid, and then being carried to the surface to be canterised, thoroughly applied to every part. Cavities may be reached by means of small portions of lint dipped in the bromine, and then carried, by means of an eye probe, or a pair of forceps, into the desired positions.

5. It is frequently beneficial to paint the surrounding tissues, to the extent of 1 inch, perhaps, with a solution of the bromine; using a drachm of the bromine to 4 ounces of water.

6. Immediately after the application of the bromine an emollient poultice should be applied. This tends to allay any undue irritation, and favours the speedy evolution of the slough.

He recommends diluted solution of the pure bromine, in the proportion of a drachm to 8 ounces of water for unhealthy-looking wounds.

Mr. Taylor is in favour of the application of nitric acid, applied with the blunt end of a probe, so that it not only destroys the cuticle, but kills the cutis vera and probably cellular membrane underneath.

Blackadder recommends the use of Fowler's solution of arsenic as an escharotic; he found that it answered well in arresting the progress of the disease at Passages and at Antwerp.

Constitutional Treatment.—Venesection was at one time strongly recommended, but it has fallen into disfavour, the typhoid type of the disease, and the demand for support, causing surgeons to be adverse to such practice.

Hennen recommends the following treatment, pursued in the epidemic at

Bilbao : on first invasion of the disease, as well as on all occasions of threatened relapse, that the *primæ viæ* be well cleared by full emetics, followed by purgatives, and that the state of the bowels and skin be carefully attended to throughout its whole progress. For local treatment, he recommends that the sores be covered with large fermenting poultices, and if there be great tension and inflammation of the limb, cloth dipped in saturnine solutions should be applied. For irritable sores, tincture of opium, camphor dissolved in oil, or paste of camphor and opium; when the fœtor is great, charcoal, either alone or mixed with bark or camphor.

Gross considers the great constitutional remedy to be opium, either in substance or in the form of morphia. It should be given in large doses generally, not less than from 2 to 4 grains every six or eight hours, in union with a diaphoretic, as ipecacuanha, tartar emetic, or the neutral mixture.

The local treatment, he says, should be of the most gentle and soothing character. Vesicles should be promptly opened, and the whole surface pencilled over with a weak solution of iodine, followed by the warm or cold water dressing, containing a large supply of acetate of lead and opium, the cloth dipped in the solution being constantly kept upon the part. If an eschar has formed, the adjacent structures should be freely rubbed with the solid nitrate of silver, and as soon as the slough has dropped off, the bottom of the sore should be thoroughly mopped with a weak solution of acid nitrate of mercury, nitric acid, or perchloride of iron, with the view of changing its action. If the tendency to spread is very great, and there is at the same time excessive pain with a feeling of tension, scarifications and incisions must be practised in the same manner, and with the same object, as in Erysipelas.

Amputation during the progress of the disease has been attended by the most unsatisfactory consequences. Hennen considers that it is most improper to attempt to operate before the fever has abated, and the sloughs begin naturally to detach themselves. To give amputation every possible chance of success, separation is indispensable; the skin should be detached as little as possible from the muscles, and the bleeding from the small vessels restrained by pressure and dossils of lint dipped in oil of turpentine, while the ligatures on the large trunks should have both ends cut short.

Hamilton is of opinion that amputations performed during the progress of the disease are, as a general rule, disastrous, for the following reasons :—The patient is in no condition to rally from the effects of the operation, and the stump is exceedingly liable to be attacked with the disease for the arrest of which the operation was performed.

ERYSIPELAS.

THIS formidable disease is the result of blood poisoning, which frequently attacks sick and wounded in civil and military hospitals, and seriously complicates surgical operations and injuries.

It may occur sporadically, without any wound, lesion, or injury, in persons exposed to cold whose health is somewhat deranged, or in a wounded person predisposed to the disease, or by contagion or infection through contamination by dressings, attendants' fingers or clothes. It may occur as an epidemic from some unknown atmospheric influence, by over-crowding of hospitals, imperfect ventilation, noxious effluvia, or want of proper sanitation; by inoculation with putrescent animal matters in patients whose constitutions are already weak and debilitated.

The exciting causes may be local injury, wounds of any kind, contusions, fractures, sprains, lacerations, wounds of extremities, scalp wounds, and exposure to cold draughts.

Lacerated and punctured wounds are more liable to its attacks than clean incised wounds; injuries about the head, hands, and knee appear especially so.

External erysipelas is generally arranged in three divisions: "1. The cutaneous; 2. The cellulo-cutaneous, or phlegmonous; and 3. The cellular or diffuse inflammation of the cellular tissue."

The first, or *cutaneous*, is of the mildest form, and is known by redness of the skin, which disappears momentarily on pressure, with severe burning or smarting pains, and swelling from effusion into the cellular tissue.

The intensity of the redness, which is the characteristic symptom of this disease, will depend very much upon the state of health of the patient, as in debilitated subjects it takes on more of a yellowish tint. In this form miliary vesicles, or large blebs, may appear about the third day, when they break and crust.

The constitutional symptoms will be rigors, alternate chills and flushes, followed by headache, nausea, hot skin, quick pulse, coated tongue, constipation, sometimes diarrhoea, and, in severe cases, delirium at night.

This form, called inflammatory erythema, frequently attacks distant parts of the body, subsiding in the part first affected, when it is known as erratic; or it may extend rapidly over the cutaneous surface. In case there is a wound or granulating surface, it takes on an unhealthy action: the edges or surface become flabby, and covered with thin serum, instead of healthy pus; granulations become pale and more or less absorbed, or the wound may become dry and the edges swollen; and when there is a tendency in a wound to unite, the adhesion gives way.

In the second, or *cellulo-cutaneous or phlegmonous*, the redness is deeper,

sometimes even dusky or purple; inflammation extends deeper into the tissues, and, if neglected, will terminate in diffuse suppuration or sloughing of them, extending to the intermuscular septa, the sheaths of the vessels and tendons, or the tendons themselves; the swelling is much greater, is hard and brawny, pitting on pressure; the pain is severe and throbbing.

The constitutional symptoms will commence as in the cutaneous form, but more intensified; they will, however, soon assume a typhoid character if the patient is weak and has been subjected to much privation and exposure; but if under the influence of proper treatment, and the patient is strong, the inflammation will subside and the disease will gradually disappear.

In the third, or *cellulo-cutaneous or diffuse inflammation*, the disease affects the areolar membrane primarily, and the skin secondarily. It is characterized by the same local and constitutional signs and symptoms as phlegmonous erysipelas, but more intense. As the disease advances, the skin becomes mottled, livid in patches, and rapidly runs into blackish sloughs. It may extend to any distance up a limb, and even invade the trunk; it will also affect the sheaths of the vessels and tendons, and the tendons themselves. The joints may also become involved, and bones be denuded of periosteum and become necrosed.

The spread of erysipelas may be arrested by applying the solid stick of nitrate of silver, moistened, outside the inflammation, care being taken that the limiting cordon is quite complete.

The treatment which should be adopted in the first form must be, to clear out the stomach and bowels by an ipecacuanha emetic and mercurial purge. Then the condition of the patient as regards constitution, age, and previous habits will be the best guide. Should he be young and robust, spare diet and diaphoretics, with the local application of fomentations, will be sufficient; but in men who have been exposed to privations, or who may be debilitated from any cause, when the disease assumes a lower type, ammonia, bark, camphor, tincture of the sesquichloride of iron, wine, and nutritious diet should be administered. The tincture of iron and also of quinine have been found most beneficial, acting speedily.


In the milder forms, the inflamed parts may be enveloped with lint wetted with subacetate of lead and opium, or with a concentrated aqueous solution of perchloride of iron, to which may be added a thick covering of cotton wool supported by a light bandage. Tincture of iodine, a strong solution of nitrate of silver, a solution of bromine or a coating of collodion may be used in the same manner.

The local abstraction of blood by leeches, cupping, or punctures is not advocated by modern surgeons. In the cellulo-cutaneous form, the object is to prevent the inflammation running into a state of gangrene; for this purpose purgatives and antimonial diaphoretics should be administered in the first instance. If the disease advance to suppuration or gangrene, it

will be necessary to support the patient by tonics, stimulants, and generous diet. The parts should be kept at rest and elevated. Poultices and fomentations, with chamomile or poppy-head applications, may check the disease; but if not successful, and it advance to suppuration or gangrene, it will be necessary to make free incisions through the cellular tissue into the fascia, which will allow the blood and effused serum to pass off; poultices or fomentations must then be applied, and as sloughing and suppuration take place, further incisions must be made to allow of their evacuation.

Dr. Copeland Hntcheson recommends incisions about $1\frac{1}{2}$ inch in length and 2 or 3 inches apart in a longitudinal direction, cutting into the fascia and beyond it, according to the extent of the inflammation.

Sir W. Laurence recommends one long incision, which has been objected to by many surgeons on account of such a wound inflicting a severe shock on the system from hæmorrhage, and the one incision not relieving the tension.

South advocates incisions arranged in fours , so as to enclose a diamond-shaped space, which relieves the tension.

Erichsen recommends that the incisions should be of limited extent, from 2 to 3 inches in length; at most they should not extend deeper than into the gelatinous-looking subcutaneous areolar tissue, unless it happens that the disease has extended beneath the fascia, when they may also be carried through it.

In the after-treatment, the limb should be well supported by soap plaster from the points of the toes or hands up to the limb, apertures being made in the strips opposite the wounds to admit of free discharge. The limb should be enveloped with cotton wool and surrounded with a bandage.

Burrowing under the skin must be prevented by following up sinuses and dividing unhealthy vascular connections. Tissues in a state of slough or gangrene will have to be gently removed, as their presence may produce most serious consequences by their decomposed condition.

In the treatment of cellular erysipelas, support may be required from the first. The local treatment is the same as in phlegmonous erysipelas.

Cold applications should never be used in any form of erysipelas.

The after-consequences of cellululo-cutaneous and cellular erysipelas may be most troublesome, the inflammation having extended to the sheaths of the tendons and the tendons themselves. There may be stiffness of joints and contraction, as frequently occurs, in the fingers, wrist, elbow, and knee, where these tendons become so completely matted together that the motions may be seriously impaired, if not destroyed, or the joints or bones may be so diseased as to require amputation of the limb.

The army surgeon is most likely to meet with diffuse inflammation after

shell wounds, or in wounds from splinters of wood. Soldiers doing duty in supply departments, and employed in the slaughtering of animals, are very liable to the disease.

On the first appearance of erysipelas, the infected individual should be removed from the vicinity of the sick or wounded, or, better still, the sick or wounded should be removed from the vicinity of the erysipelas; the latter in most cases being utterly impracticable, all that the surgeon can do is to isolate the sufferer and prevent all communication between him and the other patients, hygienic measures being at the same time enforced.

Amputation in Erysipelas.—Sir James Paget considers that in the large majority of cases, such as compound fractures or similar injuries, in which the question is raised whether a patient who seems dying with acute disease, may have what is called a chance of his life by amputation, the chance by operation seems less than that of keeping the patient alive by the ordinary treatment of erysipelas.

PHLEBITIS.

INFLAMMATION of the veins may be divided into two kinds—idiopathic and traumatic; and these again into adhesive, suppurative, and diffuse phlebitis.

The *idiopathic* form is generally of adhesive nature arising from exposure to cold and wet.

The *traumatic*, or that which the army surgeon has most frequently to contend with, may arise from a vein being wounded, and the wound not being accurately closed, or when disturbed irritation is set up, and pus allowed to enter the vessel; or it may arise from the application of a ligature, or from any description of wound to the veins (especially in unhealthy subjects and at particular seasons) which predisposes to low forms of inflammation, giving rise to symptoms of most serious nature, and not unfrequently ending in blood poisoning, pyæmia, diffuse erysipelas, suppuration.

In the idiopathic form the larger veins are generally affected, the disease being localized and limited; but in the traumatic it may occur in any vein that is wounded, the inflammation being more extended.

In both, the disease may commence with the adhesive form, but in the latter it generally runs on to suppuration.

The symptoms: An enlargement of the vein, which becomes hard, swollen, painful, and knobbed, having a reddish-purple colour; stiffness, and severe twitches through the limb, with hard, tense feel, and pitting on pressure, from the state of œdema. Much stress has been laid on this latter symptom by some authorities as a diagnostic sign in deep-seated,

adhesive phlebitis, when the vein cannot be felt, and may be the first symptom noticed. "The œdema may give rise to a hard, white, and tense condition of the limb, which pits on pressure, though in some cases the hardness is too great for this."

These symptoms may be relieved under suitable treatment ; but should the disease advance to suppuration, there will be high fever, shivering, and the usual symptoms denoting that it has taken place, or is about to do so.

The treatment at first will consist in most perfect rest ; the application of leeches along the course of the inflamed vessel ; warm applications, such as fomentations or poultices ; and, when the patient can bear it, the administration of saline purgatives. If, on the other hand, there is depression, it will be necessary to administer ammonia, bark, and stimulants. When the œdema and hardness of the limb continue, salt and nitre poultices have been recommended for their removal ; also blisters, or pressure with an elastic roller. In suppurative phlebitis, local abscesses may form, which run their course like other abscesses, and are bound and limited by inflammation, so preventing their contents entering the vessels and mingling with the current of the blood ; but should the pus by any means enter the circulation, the result will in all probability be most serious, and they should be opened without delay.

Diffuse phlebitis is generally a low form of erysipelas, which commences as an ordinary case of inflammation of the veins, but soon takes on alarming symptoms, characterized by extreme prostration, dry brown tongue, fluttering pulse, sordes on the teeth and mouth, diarrhœa, delirium, and death.

Such a case would require the same line of treatment as that recommended for diffuse erysipelas of the worst form.

PYÆMIA.

OLDER surgeons hardly recognised this disease, although correct descriptions of it are given by them under the headings of "purulent deposits," "consecutive pneumonia," "consecutive fever."

Professor Aitken defines the disease as "a febrile affection, generally sequent on wounds, or on suppurative inflammation of bone, or surgical operations, resulting in the formation of secondary abscesses in the internal visceral organs (most frequently in the lungs, liver, kidneys, spleen, and brain), and also in joints and connective tissue sometimes, but not necessarily, associated with phlebitis or embolism." The disease has lately been described under the various names of pyogenic fever, purulent infection, putrid fever, surgical fever, purulent absorption, septicæmia.

It is a disease often originating in contagion, or by inoculation conveyed

by nurses, clothing, fingers of attendants, or dressing of sores. It may appear spontaneously after acute inflammation, involving large portions of bone, or in compound fractures, accompanied by extensive laceration of the soft parts; by modes of dressing wounds preventing union by the first intention, and promoting suppuration.

Those suffering from severe injuries and wounds, or having undergone surgical operations and suppurative inflammation involving bones, veins, or joints, have the reputation of being most liable to it, especially in large hospitals, where there is over-crowding of patients with suppurating wounds; and in damp, moist weather, bad ventilation, and defective sanitary arrangements. Notwithstanding all these circumstances, which, it is said, cause the disease, it has been lately pointed out by Mr. Prescott Hewett that pyæmia occurs also in cases even when placed under the most favourable conditions—perfect isolation, large airy rooms in the country, with plenty of fresh air, and in every way well-cared for. Pyæmia appears, too, at times to be connected with atmospheric conditions; several cases occurring without any apparent cause, at or about the same period, in different places.

Surgeon Sanford Moore, 4th Dragoon Guards, who had considerable experience when aiding the sick and wounded during the Franco-German war, 1870–71, remarks: “Pyæmia and hospital gangrene proved as great scourges as ever in the hospitals. It seemed extraordinary how these diseases appeared in some buildings and not in others, although both apparently presented the same conditions for attracting the disease. Nor does the supposition of superior hygienic arrangements explain their absence from some buildings; for a very dirty building, with patients huddled together in small rooms, their personal cleanliness entirely neglected, and each man with one or more profusely suppurating wounds, was given over to our ambulance in January last, and in this building there had been no pyæmia or gangrene, although it had been occupied by a still greater number of wounded for a month back.”

Mr. Moore remarked that the diseases do not occur in hospital buildings until they have been occupied for at least ten days. He has not seen the diseases occur in a room for only one patient unless it was previously occupied by wounded. Nor has he seen them occur among patients in the upper stories of a house. A room once poisoned, no disinfection or white-washing seems to be sufficient to drive away the poison immediately, for the remaining patients placed in the room speedily become pyæmic also; and men with slight as well as severe wounds take pyæmia.

The following conditions have the credit of favouring the occurrence of the disease: debility attending convalescence after acute disease, intemperate habits, shock, hæmorrhage, nervous depression, chronic venereal disease, and exposure to transport of wounded, especially of those suffering

from compound fracture of long bones; on the other hand, the most healthy have been attacked by it.

"The attack is usually very sudden, coming on generally between the tenth and twentieth days after receipt of injury, and is marked by severe rigor, followed by profuse perspiration, which will in all probability leave the patient apparently well, but will recur in a day or so, producing great depression, the pulse becoming feeble, rapid, or variable, often intermittent, and the temperature high. The rigor may be preceded by secondary hæmorrhage, described as parenchymatous hæmorrhage, characterized by general oozing from the surface of the wound or stump.

"The sufferer may be attacked with cough, with or without expectoration, pleurisy, pneumonia, bronchitis, by peritonitis, pericarditis, or effusion in the head; but these complications may be entirely absent, or exist separately. The appetite disappears, the tongue becomes dry and brown, nausea, vomiting, and diarrhœa supervene, the countenance becomes yellow or jaundiced, delirium sets in at night. The perspirations are still more profuse and exhausting, preceded by severe rigors; abscesses rapidly form in the joints, or among the various tissues of the body; these are of a widely-spread character, and very insidious, as they often occur without any local signs (the pus sometimes infiltrating the cellular tissue and muscles of a trunk to a great extent), and are most frequently met with in the axilla, in the groin, back, iliac fossa, thigh and calf of the leg, giving rise to much suffering and exhaustion, from which the patient rapidly sinks. The disease may be at first mistaken for ague, rheumatism, or typhoid fever, but the continued rigors, followed by profuse perspirations, exhaustion, and suppuration, will soon declare the true nature of the disease."

The prognosis is most unfavourable. The disease is usually fatal; mild cases may recover, but when it is acute, when the rigors quickly follow one another, when the pulse is unsteady, the temperature high, and the patient restless, the disease will in all probability prove rapidly fatal.

Treatment.—An endeavour should be made to purify the blood, and keep up the strength of the patient. The first indication must be done through change of air, strict cleanliness, good ventilation, administration of such remedies as will obviate the contamination of the blood. If the tongue is foul, and there appears to be hepatic congestion, calomel, followed by a purgative, should be given at once; this may be followed by the administration of the chlorate of potash, and some of the mineral acids, such as hydrochloric acid and nitro-muriatic acid. Professor Polli suggests such agents as will prevent the process of vinous fermentation going on in the blood, caused by the introduction of septic poison: those are sulphurous acid in combination with either soda, potash, magnesia, or lime, given in large doses.

Mr. W. MacCormac, in referring to Professor Polli's antizymotic treatment, says : "It appeared to me to do a good deal of harm, and never much, if any, good ; diarrhœa was induced by it, as well as vomiting. The abdomen swelled up with flatulence, and food was soon rejected." For himself he can place little reliance in anything save quinine and opium and plenty of fresh air, and not much even in these means for staying the progress of acute pyæmic poisoning.

In the chronic form of pyæmia, liquor potassæ in drachm doses three times a day has been followed by good results, in causing the absorption of morbid deposits.

The second indication may be carried out by giving brandy, wine, ammonia, bark, quinine, and nutritious diet : above all, hygienic measures must be strictly enforced as far as possible, which may be a difficult point to attend to, when the accommodation may be limited, the weather inclement, and no means of preventing overcrowding. The surgeon should keep in view the experience obtained during the war of 1870-71, when it was observed that pyæmia occurred most frequently in permanent buildings ; next in frequency in huts, and last of all in tents. Pure air is of the greatest importance, and one must ever remember the remarks of Sir J. Paget, who declares that *the few patients whom he had known to recover from the disease, owed their lives to being kept in a current of fresh air.*

Mr. Jessop, of Leeds, recommends that when pus forms in joints, it be removed with the pneumatic aspirator. He records two cases in which the result was satisfactory, the recovery being complete and rapid.

The primary lesion should be kept clean, cool, and disinfectants applied. Abscesses frequently occur in the neighbourhood of the lesion connected with injured bone ; these should be searched for and evacuated.

The cauterization of superficial veins on the proximal side of the diseased part, with a view to prevent the further entrance of poisonous matter into the blood, has been suggested.

Operations during Pyæmia.—The opinion given by Sir J. Paget is, that, with acute pyæmia, in which the patient has rigors once or more in a few days, and profuse sweatings, with very rapid pulse and breathing, and with delirium, and rapid wasting, or with dry tongue and yellowness of skin, or any considerable number of these symptoms, the probability of good is so small and of harm so great that you should refuse to operate. But if the pyæmia have become chronic, attended with only wasting and sweating and the formation of abscesses here and there, and if the injured part be manifestly useless, or a source of irritation or of exhaustion, the mere existence of pyæmia in the chronic form need not deter the surgeon from the necessary operation.

SEPTICÆMIA.

THIS disease has been described by some authors as being one and the same disease as pyæmia, and by others as being of the same group, having definite and distinct characteristic symptoms. There is no doubt that it bears much resemblance to it in its origin and results, but its progress differs materially in many points. M. Verneuil holds that all surgical fevers are so many different forms of septicæmia; he believes that the disease may be developed spontaneously from decomposing organic matter in the surface of the wound. The poison thus created he calls *sepsine*, and he thinks that having been generated in a wound, it is inoculable in infinitesimal doses, and acts as a *ferment*, producing the disease septicæmia.*

M. Gosselin maintains that septicæmia only arises from the introduction of a specific poison from without, through the wound surface, and so into the blood.†

“Septicæmia is frequently associated with, or rather the sequel of, thrombosis, embolism, and phlebitis, arising probably in these morbid conditions from softening, breaking-up, putrefaction, and absorption of coagula; or it may occur in connection with gangrenous osteo-myelitis and osteo-phlebitis. The symptoms are swelling and discoloration of the affected limb, œdema, from infiltration, which pits on pressure.”

There are high fever and temperature at the outset, not preceded as a rule by rigor, or followed by profuse perspiration; and if these do occur, they seldom recur during the progress of the disease. The skin is dry, no jaundice, but great prostration, with a temperature, as the disease advances, lower than the normal standard. Abscesses do not generally form in the viscera or joints.

The treatment will be the same as in pyæmia. An endeavour should be made to try and eliminate the poison from the blood, by the administration of antiseptics, supporting the constitution with good wholesome diet and stimulants, attention being paid to cleanliness and pure air.

Warmth, in the form of fomentation or poultices, should be applied to the injured part.

OSTEO-MYELITIS.

INFLAMMATION of the medullary membrane may occur in an acute or chronic form, the former being most likely to be met with in warfare, as the result of gun-shot injuries or amputation. It may, however, as Professor Fayrer remarks, have its origin in any wound, injury, or contusion of the bone, or of its periosteum or medullary membrane; in sudden extremes

* Gordon's "Lessons on Hygiène and Surgery," p. 198.

† *Ibid.* p. 198.

of heat or cold, constitutional vice, such as syphilitic or strumous deposits of bone, or necrosis of the exterior extending inwards, and so causing mischief there. He is at the same time unable to explain why it should occur when the healthy condition and vigorous granulation of the soft parts of the same limb, or of other wounds treated in the same wards, and under similar local influences, indicate that the hygienic conditions generally are favourable. The occurrence of this disease after gun-shot injuries or amputation must be looked upon as most dangerous, in all probability necessitating excision of the injured bone, amputation, or disarticulation.

Some difficulty has been experienced by writers in deciding as to the cause of this formidable disease. Some attribute it to hospital influences, that is, unfavourable hygienic conditions; others to the result of irritation, such as may be produced by wounded being roughly carried after a comminuted gun-shot fracture.

It was remarked, during the Franco-Prussian War, 1870-71, that gun-shot fractures, owing either to the nature of the missiles or to the transport of the patients, were attended in a most remarkable manner by suppurative osteo-myelitis.

Professor Longmore remarks: "It is not believed that any essential difference exists between the nature of the inflammation of the medullary tissue when developed by gun-shot wounds, and the inflammation which occasionally arises after the ordinary injuries and amputations of civil life; but it is its comparative frequency after gun-shot injuries, and after amputation consequent upon them, in men of previously sound constitutions in military practice, contrasted with the comparative rarity of its occurrence in patients of sound constitutions in civil practice, that has caused attention to be so much directed to it, and to its proper treatment by army surgeons."

The presence of the disease may be suspected when, after an operation or injury, the patient is attacked with shivering, deep-seated pain, and swelling. If it be an amputated bone, the medulla will protrude like a fungus, and the periosteum will be detached from the bone, the soft parts retract, and the bone appear dry and discoloured.

Fayrer says: "The symptoms in this formidable disease are, in the outset, said to be obscure. The local symptoms, no doubt, may be so when the affected bone is unexposed or undivided. The constitutional symptoms are those of pyæmia, and, at the outset, may be mistaken for a mere access of fever, a rigor such as may follow any surgical operation, or may occur from other causes. But as the local and constitutional symptoms progress, the doubt is soon cleared up. The symptoms, in the acute form, generally make their appearance early, within a week or ten days. It may be earlier, after the operation, wound, or injury. The stump, wound, or

contusion may have been doing well. It may, perhaps, have sloughed a little, and the sloughs have cleared away, healthy granulations having appeared. The flaps may have united almost by the first intention, or all but at a point or two, whence discharge continues. The pain is not necessarily acute, and the tenderness on pressure of the stump is but slightly increased. The discharge becomes more profuse, but it is not healthy, well-elaborated pus. A probe being introduced, the bone is found dry and denuded, and, if exposed, the medulla will probably be found protruding like a fungus, whilst the periosteum is stripped from the end of the bone. With all this there may have been only a quickened pulse; or a febrile condition at some time of the day, the temperature at others being at, or even below, the natural standard; or rigors, as yet so slight as hardly to have attracted attention, may have occurred. Such are the early stage and symptoms, local and constitutional. These rapidly progress and develop themselves in the most marked manner. And now the critical period has arrived when it is necessary to make a thorough examination, and decide the question whether it be osteo-myelitis or not. Exploration should be made with the finger, the stump, if necessary, being sufficiently reopened to admit of doing so, and the condition of the bone should be carefully examined and ascertained. In incipient cases the medulla will be found protruding like a fungus, and the bone surrounding it exposed to a greater or lesser extent. At a later period, the end of the medulla is found already blackened and encrusted, but within it is a putrid mass of bone debris and pus—a probe readily passing down the entire length of the shaft. In the former stage you can wait and watch progress, the mischief may be limited, and a ring of bone be thrown off. But in the latter case immediate interference is necessary, and nothing less than amputation, either at or above the next joint, will suffice. The constitutional symptoms will also have indicated the necessity for interference, and they are the symptoms of *pyæmia* of a marked character."

"The condition of the soft parts must not deceive. It is no uncommon thing to see the dead and putrid bone lying in the midst of perfectly healthy soft parts, and therefore the condition of the bone and the constitutional symptoms must be the guide as to the time and necessity for operation."

In cases where the symptoms may lead one to suspect that osteo-myelitis is taking place in a bone that has not had its medulla, or even its surface, exposed, the trephine, if it can be applied, should be had recourse to; and the discovery that the cavity of the bone is the seat of diffuse suppuration, as a general rule, lead to amputation or excision. Removal of the diseased bone being the only means of affording any prospect of recovery, the question is, whether amputation of only the portion diseased, or of the limb, is necessary.

Baron Larrey was of opinion that the disease might be limited, extend partially, or invade the whole of the bone; he, therefore, considered that resection was sometimes necessary, sometimes consecutive amputation, and sometimes disarticulation.

M. Jules Roux, in consequence of the fatal results of amputation and resection for this disease, proposed and carried out disarticulation of the injured bone. Of twenty-two cases in which he performed secondary disarticulation of joints for osteo-myelitis, all recovered; whereas every soldier died whose limb was secondarily amputated, through the continuity of the injured bone, after the battles of Magenta, Montebello, and Solferino.

Mr. Longmore considers that, "if amputation in continuity be performed while the endosteum is suffering from the inflammatory irritation excited by the violent injury to which the whole bone has been subjected, especially when this has assumed a chronic form, the endosteitis will most probably still pursue its course, even though the divided soft parts may at first become healed, slowly inducing death, more or less extensive, of bony tissue, and in time the usual consequences of such a condition throughout the whole stump.

"The morbid condition of the endosteum does not usually extend from the shafts of bones into their apophyses.

"When amputation has been followed by the disease, exarticulation should not in any case be resorted to for the removal of the diseased stump, until the effect of complete removal of every particle of the dead bone by proper surgical measures has been ascertained.

"Experience shows that, although a patient's constitution may be greatly impaired by the prolonged local diseased action to which it has been subjected, and though there may be every reason to conclude that the articular extremity of the bone is in the condition understood by the term "osteoporosis," yet the complete removal of the endosteitic sequestra may speedily be followed by a restoration of the general health, and by a condition of the stump so sound and firm that it may be applied to any purpose of utility for which it may be competent, according to its length and position."

Fayrer does not urge the operation of disarticulation always in preference to section of the bone at the next segment of the limb. He says, in the cases of the hip and shoulder, disarticulation, of course, alone is practicable; whereas in the leg and forearm, the respective advantages of disarticulation at the elbow or knee may fairly be questioned—and he has no hesitation in saying that, except in cases of endemic tendency to osteo-myelitis, section of the humerus or femur, in their lower third, is as good an operation as disarticulation, if not better than the latter. The great point to be attained is the removal of the whole of the suppurating bone. Whenever there is an

endemic tendency to osteo-myelitis in a hospital, this disarticulation, though, in itself, inferior as an operation to section of the bone (according to his view in the case of elbow and knee), should be preferred to amputation through the bone, as the fresh bone-wound might, under the endemic influence, give rise to an attack of osteo-myelitis.

Operative measures should be adopted at an early period, before pyæmic symptoms have commenced to appear, as, once that disease has set in, amputation, disarticulation, or excision are of no avail. It is, however, a difficult point to decide how long amputation may be deferred on the chance of the mischief being limited, and the diseased part thrown off without the constitution being affected.

The constitutional treatment in this disease should be improvement of the system by tonic wine, nutriment, change of air, and strict attention to hygienic conditions.

SCURVY.

WHEN scurvy presents itself among soldiers in time of war, it appears under different forms, such as swelling of the limbs, ulceration, especially of old cicatrices, having a livid colour and irregular tumid border, with a surface covered with a spongy, dark-coloured, strongly-adherent foetid crust, dysentery, hæmorrhage, nodes, spongy swelling in the gums and petechiæ: rendering the subjects quite inefficient, and *aggravating wounds or injuries* by preventing their healing.

“Measures to be adopted in time of war, or in prolonged sojourn on board ship, or at stations where fresh vegetables are scarce, are—

“1. The supply of fresh vegetables and fruits by all the means in our power. Even unripe fruits are better than none, and we must risk a little diarrhœa for the sake of their antiscorbutic properties. In time of war every vegetable should be used, which it is safe to use, and when made into soups, almost all are tolerably pleasant to eat.

“2. The supply of the dried vegetables, especially potato, cabbage, and cauliflowers; turnips, parsnips, &c., are perhaps less useful; dried peas and beans are useless. As a matter of precaution, these dried vegetables should be issued early in a campaign, but should never supersede the fresh vegetables.

“3. Good lemon-juice should be issued daily (1 oz.), and it should be seen that the men take it.

“4. Vinegar ($\frac{1}{2}$ oz. to 1 oz. daily) should be issued with the rations, and used in the cooking.

“5. Citrates, tartrates, lactates, and malates of potash, should be issued in bulk, and used as drinks, or added to the food. Potash should be selected as the base, as there is seldom any chance of the supply of soda being lessened.

The easiest mode of issuing these salts would be to have packets containing enough for one mess of twelve men, and to instruct the men how important it is to place them in the soups or stews. Possibly they might be mixed with the salt, and issued merely as salt.*

Iron, in the form of the tincture of the perchloride, in doses of 30 drops three times a day, has been recommended by Dr. Hammond for this disease. Attention should be paid to cleanliness, air, and exercise.

FOOTSORENESS.

PROFESSOR PARKES remarks : "Footsoreness is generally a great trouble, and frequently arises from faulty boots, undue pressure, chafing, riding of the toes from narrow soles, &c. Rubbing the feet with tallow, or oil, or fat of any kind, before marching, is a common remedy. A good plan is to dip the feet in very hot water, before starting, for a minute or two ; wipe them quite dry, then rub them with soap (soft soap is the best) till there is a lather ; then put on the stocking. At the end of the day, if the feet are sore, they should be wiped with a wet cloth, and rubbed with tallow and spirits mixed in the palm of the hand (Galton). Pedestrians frequently use hot salt and water at night, and add a little alum. Sometimes the soreness is owing simply to bad stockings ; this is easily remedied. Stockings should be frequently washed, then greased. Some of the German troops use no stockings, but rags folded smooth over the feet. This is a very good plan.

"Very often soreness is owing to neglected corns, bunions, or in-growing nails ; and the surgeon must not despise the little surgery necessary to remedy these things ; nothing, in fact, can be called little if it conduces to efficiency.

"If blisters form on the feet, the men should be directed not to open them during the march, but at the end of the time to draw a needle and thread through the blister ; the fluid then gradually oozes out.

"All footsore men should be ordered to report themselves at once.

Chafing.—"Occasionally men are much annoyed with chafing between the nates or inside of the thighs. Sometimes this is simply owing to the clothes, but sometimes to the actual chafing of the parts. Powders are said to be the best—flour, oxide of zinc, and, above all, it is said, fullers' earth."

TREATMENT OF THE DROWNED.

Rule 1. *Draw off the Water from the Chest and Stomach.*—Instantly strip the patient to the waist. Place him face downward, the pit of the stomach being raised above the level of the mouth by a large, hard roll of clothing

* Parkes' "Manual of Practical Hygiène," p. 492.

placed beneath it. Throw your weight forcibly two or three times, for a moment or two, upon the patient's back, over the roll of clothing, so as to press all fluids in the stomach out of the mouth.

Rule 2. *To perform Artificial Breathing.*—Quickly turn the patient upon his back, the roll of clothing being so placed beneath as to make the breast bone the highest point of the body. Kneel beside or astride the patient's hips. Grasp the front part of the chest on either side of the pit of the stomach, resting your fingers along the spaces between the short ribs. Brace your elbows against your sides, and steadily grasping and pressing forward and upward, throw your whole weight upon the chest, and gradually increasing the pressure while you can count *one—two—three*. Then suddenly let go with a final push, which springs you back to your first position. Rest erect upon your knees, while you can count *one—two*: then make pressure again as before, repeating the entire motions at first about four or five times a minute, gradually increasing to about ten or twelve times. Use the same regularity as in blowing bellows, and as is seen in natural breathing, which you are imitating.

If another person be present, let him with one hand, by means of a dry piece of linen, hold the tip of the tongue out of one corner of the mouth, and, with the other hand, grasp both wrists and pin them to the ground above the patient's head.

After-Treatment.—After the breathing has become natural, dry the patient briskly. Wrap him in blankets only, and let him be kept perfectly quiet. Provide free circulation of air, give brandy and water—a tea spoonful every five minutes the first half hour, and afterwards occasionally as may seem expedient.*

COOKING-PLACES.

“THE simplest kitchen consists of a trench dug in the direction that the wind is blowing, of such width that the kettle, when placed on it, should not rest above an inch on each side. When the width is 9 inches, its depth should be 12 at the end from which the wind is blowing, and continue that depth for 4 feet, decreasing then gradually to 3 inches at the opposite end, where a space must be left equal to the breadth of the trench, to serve for a chimney. The fire is lit at the end where the trench is deep; it should not extend beyond 3 or 4 feet up the trench. The kettles are placed touching one another along this trench; dry sods should be used to stop up the chinks made by the roundness of the kettles, so that the space under them may form a flue. It is advisable to pile up sods, or, with stones and earth, to erect a chimney of at least 1 foot in height at the end away from the

* Method recommended by Dr. Benjamin Howard.

fire. All grass round the fire-places should be cut to prevent accidents from fire.

"These kitchens are susceptible of great improvement. The chimney can be made of mud, or wattle and daub, and the draught may be increased by using short pieces of hoop-iron, as bars stretched across the trench to support a filling-in of clay round each kettle, or, in other words, to make a regular place for the kettle, into which it will fit exactly, so that its position may be frequently changed, to prevent the contents of one being cooked before the other. As the day following the wind may change to an exactly opposite direction, a similar trench must be dug in continuation of the former one, the same chimney being used. In this manner the same chimney will serve for trenches cut to suit the wind blowing from all four quarters. The openings from these trenches into the chimney must all be closed with a sod, except the one to be used when the fire is lit. In some places, where bricks or stones suitable to the purpose are to be had, it is better to construct these kitchens on the ground instead of below its surface.

"In well-wooded countries, like America, two logs rolled together in the direction of the wind, the fire being kindled between them, make a good kitchen. In such places fuel is no object, so the construction of chimneys can be dispensed with, and the kettles hung from a stick resting at each end in a forked upright.

Field Ovens.—"The simplest method of making them is as follows: Take any barrel (the more iron hoops on it the better), the head being out; lay it on its side, having scraped away the ground a little in the centre to make a bed for it; or, if there is a bank near, excavate a place for it, taking care that the end of the barrel does not reach within 6 inches of the edge of the bank; cover it over with a coating of about 6 or 8 inches of wet earth or thick mud, except at the open end, which is to be the mouth of the oven. Pile up some sand or earth to a thickness of about 6 inches over the mud, leaving for an opening 3 inches in diameter being left as a flue (to increase the draught) to lead from the upper side of the barrel, at the far end, through the mud and earth. This flue is only left open when the fire for heating is burning. When bread is put in, it should be covered over. Form an even surface of well-kneaded mud at the bottom within the barrel, to form a flooring to place the bread on. Light a fire within the barrel, and keep it up until the staves are burnt. You will then have a good oven of rough, burnt clay, tied together by the iron barrel-hoops. When required for use, heat it as if it was an ordinary oven. When the ashes are drawn out, and the bread put in, close the mouth with some boards, or a piece of iron or iron."*

* "The Soldier's Pocket-Book," by Col. Sir Garnet Wolseley, p. 152.

LATRINES.

A LATRINE should be made as soon as the hospital arrives on the ground. A small shallow trench will suffice for one night.

In standing camps, latrines may be with seats, as shown in fig. 151. The seat being a simple pole, additional comfort may be given by adding a top pole to form a back; but this is quite needless, except for hospitals. The trench should be made as narrow as possible, and from 3 to 4 feet deep. Too much care cannot be bestowed in selecting the site of the latrine, and placing it so that no filtration from it may reach the water supply. A

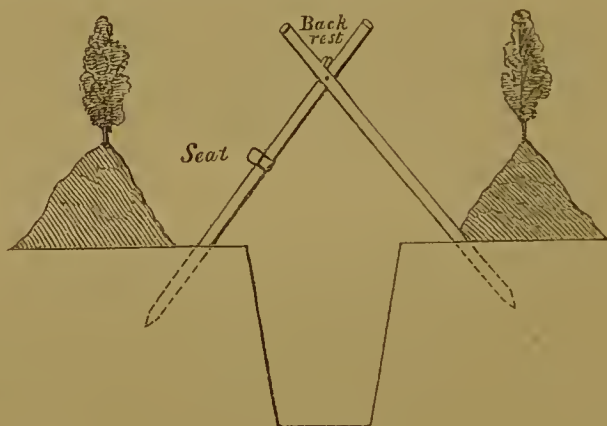


Fig. 151.*

small piece of canvas may be carried to give some shelter to the latrine. If trees or brush are in the neighbourhood, it can be inclosed by a screen about 4 feet high. Twice a day, about 10 A.M. and 6 P.M., the bottom of the pit should be covered with a 3-inch layer of dry earth. The wood ashes from the cooking-places should be spread about in the vicinity. Lime, if it is to be had, should be used in large quantities.

The health and comfort of every one in hospital depends very much upon the manner in which these duties are conducted.

* Fig. 151 is taken from Regulations and Instructions for Encampments. Horse Guards, 1st August, 1871, plate xxvi.

WATER.

PURE water being so essential, the following instructions may be given here : " When halting-ground is reached, it may be necessary to filter the water. A common plan is to carry a cask, charred inside, and pierced with small holes at the bottom ; it is sunk in a small stream, and the water rises through the holes. A better plan still is to have two casks, one inside the other : the outer pierced with holes at the bottom, and the inner near the top ; the space between is filled with sand, gravel, or charcoal if procurable ; the water rises through the gravel between the barrels, and flows into the inner barrel (fig. 152). It is advisable to heat sand, gravel, or earth, to redness before use ; the same applies to charcoal if there be any question of its purity. *All* these media must be changed frequently, or else purified by heating to redness.

" In the French army it is ordered that, if other means cannot be procured, fresh and inodorous straw be taken, and chopped fine, and pressed

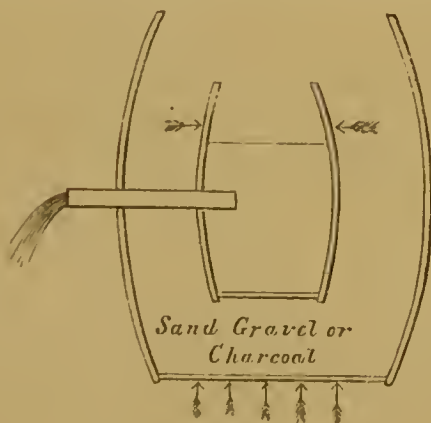


Fig. 152.

at the bottom of a tube pierced with holes ; if possible, charcoal is to be intercalated among the straw. Great care must be taken to have the straw pure, and to change it often.

" Medical officers should make arrangements for the different places of supply. Men and cattle should be watered at different points ; places should be assigned for washing ; and if removal of excreta by water be attempted, the excreta should flow in far below any possible spring. In

case of a spring, several reservoirs of wood should be made, and the water allowed to flow from one to another—the highest for men, the second for cattle. If it is a running stream, localities should be fixed for the special purpose; that for the men's drinking-water should be highest up the stream, for animals below, washing lowest; sentries should be placed as soon as possible.

"The distribution of water should be regulated; streams are soon dried up, made turbid, and the water becomes undrinkable for want, perhaps, of simple management."

"Water may be filtered through a sponge, or a cloth of any kind; or by rolling a handful of grass in the form of a cone, and having dipped it into the pool, allowing it to drip from one end."

In India, especially on board river steamers, where drinking-water is taken direct from the river, which is generally very muddy, a lump of alum is moved rapidly through it with satisfactory results.

In the Ashanti campaign of 1873, the water was purified by Surgeon-Major Gouldsbury's direction in the following way, in the absence of proper filters:—Alum was added to precipitate suspended matter—the water was passed through a rough filter, consisting of (1) sponge, (2) sand, (3) charcoal in pieces; it was then boiled, and a few drops of solution of potassium permanganate added. Water, even taken from a hole in a marsh, was innocuous after this treatment.*

As it is unlikely that any organic poison will resist the temperature of boiling, it is of the greatest importance that all suspicious water should be boiled before use. During epidemics, such as cholera, this is essential; it may even be advisable to try and supply the men with distilled water at such times; any sort of rough still would answer. One great advantage would be that impure water could not be substituted for it, as a few drops of solution of nitrate of silver would at once detect the presence of chlorides, which are present in all except distilled water.

In judging of water a few rough qualitative tests may be useful. 1st. Try as far as possible to get water that is clear, free from sediment, and colourless. 2d. Test it with a little nitrate of silver solution and a few drops of dilute nitric acid: good water should give only a faint haze. 3d. Add a few drops of Nessler's solution; good water should give no colour; a yellow tinge makes the water suspicious. 4th. Add a little permanganate of potash solution: good water should remain pink for about ten or fifteen minutes, if the colour fades rapidly or becomes brown the water is to be suspected. 5th. Add some solution of starch, a little iodide of potassium solution, and a few drops of dilute sulphuric acid; if a blue colour appears

* "Manual of Practical Hygiene," 5th edition, p. 31. Edited by Professor de Chaumont.

at once, or within a minute or two, the water is suspicious. Other tests may be added, but these are generally sufficient for practical purposes, while they entail the use of no special apparatus.

DIETS.

The following scale of diets is now in use in fixed hospitals.

On service in the field, the sick and wounded would be supplied with their usual daily rations, which might be supplemented by medical comforts, or by such articles as the Supply Department might be able to provide.

DIET

Military Hospitals.—Articles composing the

Tea.	Milk.	Low.	Chicken.
Bread . . 12 oz.	Bread . . 12 oz.	Beef . . 8 oz.*	Fowl . . 8 oz.*
Tea . . . $\frac{1}{2}$ „	Rice . . 2 „	Bread . . 14 „	Bread . . 16 „
Sugar . . . $2\frac{1}{2}$ „	Milk . . 3 pints	Salt . . . $\frac{1}{2}$ „	Potatoes . 8 „
Milk . . . 6 „	Sugar . . 1 oz.	Tea . . . $\frac{1}{4}$ „	Salt . . . $\frac{1}{2}$ „
		Sugar . . . $1\frac{1}{2}$ „	Tea . . . $\frac{1}{4}$ „
		Milk . . . 6 „	Sugar . . . $1\frac{1}{2}$ „
		Butter . . 1 „	Milk . . . 6 „
			Butter . . 1 „
		* Without bone.	* 10 (if with bone).

BREAKFAST.

Tea . . . 1 pint	Milk . . . 1 pint	Tea . . . 1 pint	Tea . . . 1 pint
Bread . . 4 oz.	Bread . . 4 oz.	Bread . . 5 oz.	Bread . . 6 oz.
		Butter . . $\frac{1}{2}$ „	Butter . . $\frac{1}{2}$ „

DINNER.

Tea . . . 1 pint	Rice Milk 1 pint	Beef tea . . 15 oz.	Fowl . . 8 oz.
Bread . . 4 oz.	Bread . . 4 oz.	Bread . . . 4 „	Either roasted, boiled, stewed, or made into chicken tea . . 12 oz.
	Sugar . . 1 „		Bread . . 4 „
			Potatoes . 8 „

SUPPER.

Tea . . . 1 pint	Milk . . . 1 pint	Tea . . . 1 pint	Tea . . . 1 pint
Bread . . 4 oz.	Bread . . 4 oz.	Bread . . 5 oz.	Bread . . 6 oz.
		Butter . . $\frac{1}{2}$ „	Butter . . $\frac{1}{2}$ „

Note.—Drinks for patients are to be made and charged according to the following proportions:—

Barley Water.—Barley, 2 oz.; sugar, 2 oz.; for every five pints.

Rice Water.—Rice, 2 oz.; sugar, 2 oz.; for every five pints.

TABLE.

Different Diets for a day.—Avoirdupois Weight.

Half.	Roast.	Entire.	Varied.
Meat (Beef or Mutton) 8 oz.*	Roast Joint, Chop, or Steak.	Meat (Beef or Mutton) . 12 oz.*	Meat (Beef or Mutton) . 12 oz.*
Bread . . 16 „	—	Bread . . 16 „	Bread . . 18 „
Potatoes . 8 „	Joint (Beef or Mutton, with bone) . 10 oz.	Potatoes . 16 „	Potatoes . 16 „
Barley . . 1½ „	Chop (Beef or Mutton, with bone) . 10 oz.	Barley . . 1½ „	Salt . . . ¾ „
Salt . . . ¾ „	Steak (with- out bone) 8 „	Salt . . . ¾ „	Tea . . . ¼ „
Tea . . . ¼ „	Bread . . 18 „	Tea . . . ¼ „	Sugar . . 1½ „
Sugar . . 1½ „	Potatoes . 8 „	Sugar . . 1½ „	Milk . . . 6 „
Milk . . . 6 „	Salt . . . ¾ „	Milk . . . 6 „	Vegetables 4 „
Vegetables 4 „	Tea . . . ¼ „	Vegetables 4 „	Butter . . 1 „
Butter . . 1 „	Sugar . . 1½ „	Butter . . 1 „	—
Flour . . ¼ „	Milk . . . 6 „	Flour . . ¼ „	Meat — roasted, baked, or stewed.
	Vegetables 4 „		
	Butter . . 1 „		
10 (if with bone).		* 15 (if with bone).	* 15 (if with bone).

BREAKFAST.

Tea . . 1 pint	Tea . . 1 pint	Tea . . 1 pint	Tea . . 1 pint
Bread . . 6 oz.	Bread . . 6 oz.	Bread . . 6 oz.	Bread . . 6 oz.
Butter . . ½ „	Butter . . ½ „	Butter . . ½ „	Butter . . ½ „

DINNER.

Soup . . 15 oz.	Roast Joint, Chop, or Steak roasted or stewed.	Soup . . 1 pint	Meat . . 12 oz.
Meat . . 8 „	—	Meat . . 12 oz.	Bread . . 6 „
Bread . . 4 „	Meat . . 8 oz.	Bread . . 4 „	Potatoes . 16 „
Potatoes 8 „	Bread . . 6 „	Potatoes 16 „	Vegetables 4 „
	Potatoes . 8 „		
	Vegetables 4 „		

SUPPER.

Tea . . 1 pint	Tea . . 1 pint	Tea . . 1 pint	Tea . . 1 pint
Bread . . 6 oz.	Bread . . 6 oz.	Bread . . 6 oz.	Bread . . 6 oz.
Butter . . ½ „	Butter . . ½ „	Butter . . ½ „	Butter . . ½ „

Gruel.—Oatmeal, 2 oz.; and sugar, 1½ oz., to two pints.*Lemonade.*—Two large lemons; and sugar, 1½ oz., to two pints.*Beef Tea.*—Eight oz. of meat for ¾ of a pint.

APPENDICES

Nos. I., II., III., AND IV.

TABULAR FORMS FOR THE CLASSIFICATION
OF
WOUNDS AND INJURIES.

APP. I.—DESCRIPTIVE NUMERICAL RETURN* OF WOUNDS AND INJURIES received in Action, admitted into the Hospital of the _____, between the _____ of _____, and _____ of _____ 18_____.
 _____ the _____ of _____ 18_____.

Classification and Specification of Wounds and Injuries.		Remained on the 18_____	Since admitted.	Died.	Discharged to duty.	Transferred.			Remaining on the 18_____
						To other hos- pitals.	Re-admitted for other diseases.	Re-admitted for capital op.	
1. Gun-shot wounds of the Head.	1. Contusion and simple flesh wounds of scalp { Slight Severe								
	2. With contusion or fracture of the cranium, without depression .								
	3. Ditto, with depression								
	4. Penetrating the cranium								
	5. Perforating ditto								
2. Gun-shot wounds of the Face.	1. Simple flesh contusions { Slight and wounds { Severe								
	2. Penetrating, perforating, or lacerating the bony structure without lesion of important organs								
	3. Ditto, with lesion of the								
	4. With fracture of the lower jaw .								
3. Gun-shot wounds of the Neck.	1. Simple flesh contusions { Slight and wounds { Severe								
	2. With injury of the { _____ _____ _____								
Carried forward									

* Classification arranged by Inspector-General Taylor, C.B.

APP. I.—DESCRIPTIVE NUMERICAL RETURN OF WOUNDS AND INJURIES.—continued.

Classification and Specification of Wounds and Injuries.		Remained on the 18	Since admitted.	Died.	Discharged to duty.	Transferred.			Remaining on the 18
						To other hospitals or stations.	Re-admitted for other diseases.	Re-admitted for capital op.	
4. Gun-shot wounds of the Chest.	Brought forward								
	1. Simple flesh contusions and wounds	{ Slight Severe							
	2. With injury of bony or cartilaginous parietes without lesion of contents								
	3. With lesion of contents by contusion or with non-penetrating wound								
	4. Penetrating, and ball lodged, or apparently lodged								
5. Gun-shot wounds of the Abdomen.	5. Perforating contusions	{ Superficially Deeply							
	1. Simple flesh contusions and wounds	{ Slight Severe							
	2. Contusion or non-penetrating wound with lesion of								
	3. Penetrating or perforating, with lesion of								
6. Gun-shot wounds of the Back and Spine.	1. Simple flesh contusions and wounds	{ Slight Severe							
	2. With fracture of vertebra, without lesion of spinal cord								
	3. With lesion of spinal cord								
	Carried forward								

APP. I.—DESCRIPTIVE NUMERICAL RETURN OF WOUNDS AND INJURIES.—*continued.*

Classification and Specification of Wounds and Injuries.		Remained on the 18	Since admitted.	Died.	Discharged to duty.	Transferred.			Remaining on the 18
						To other hospitals or stations.	Re-admitted for other diseases.	Re-admitted for capital op.	
Brought forward									
7. Gun-shot contusions and wounds of the perineum and genital and urinary organs, not being at the same time wounds of the peritoneum									
8. Gun-shot wounds of the Upper Extremities.	1. Simple flesh contusions (Slight and wounds) Severe								
	2. With contusion and partial fracture of long bones, including fracture of the clavicle and scapula								
	3. Simple fracture of long bones by contusion from round shot								
	4. With compound fracture of . . .	Humcrus							
		Radius							
		Ulna							
9. Gun-shot wounds of the Lower Extremities.		Ulna and radius							
		All three bones							
	5. Penetrating, perforating, or lacerating the several structures of the carpus and metacarpus								
	6. Dividing or lacerating the structures of the fingers or thumbs								
9. Gun-shot wounds of the Lower Extremities.	1. Simple flesh contusions (Slight and wounds) Severe								
	2. With contusion and partial fracture of long bones								
	3. With simple fracture of long bones by contusion of round shot								
Carried forward									

APP. I.—DESCRIPTIVE NUMERICAL RETURN OF WOUNDS AND INJURIES.—continued.

Classification and Specification of Wounds and Injuries.		Remained on the 18	Since admitted.	Died.	Discharged to duty.	Transferred.			Remaining on the 18
						To other hospi- tals or stations.	Re-admitted for other diseases.	Re-admitted for capital op.	
Brought forward									
9. Gun-shot wounds of the Lower Extremities— <i>contd.</i>	4. With com- pound frac- ture of . .	Femur							
		Tibia only							
		Fibula only							
		Tibia and fibula							
		5. Penetrating, perforating, or lace- rating the several structures of the tarsus and metatarsus	All three bones						
	6. Dividing or lacerating the struc- tures of the toes								
0. Gun-shot wounds with direct injury of the large Arteries, not being at the same time cases of compound fracture									
1. Gun-shot wounds with direct penetration or perforation of the larger Joints) With fracture of bone) Without fracture							
2. Gun-shot wounds with direct injury of the large Nerves, not being at the same time cases of compound fracture									
3. Sword and lance wounds of									
Bayonet wounds of									
Carried forward									

APP. I —DESCRIPTIVE NUMERICAL RETURN OF WOUNDS AND INJURIES.—*continued.*

Classification and Specification of Wounds and Injuries.	Remained on the 18	Since admitted.	Died.	Discharged to duty.	Transferred.				Remaining on the 18
					To other hospi- tals or stations.	Re-admitted for other diseases.	Re-admitted for capital op.		
Brought forward									
15. Miscellaneous wounds and injuries received in action {									
Total wounds and injuries received in action									

The Tables on pages 290 and 291 (Appendices III. and IV.) represent the Forms of Returns for Injuries inflicted in particular battles, and for the results of their hospital treatment.

App. II.—Return of Capital Operations.

Transferred.

Excisions.		Amputations.		Remained on the	Since admitted.	Died.	Discharged cured.	To other hospi-	Re-admitted for	Remaining on the	
Lower Extremities.		Upper Extremities.		18				tals or stations.	other diseases.	18	
			Shoulder-joint								
			Arm								
			Forearm								
			Thumbs								
			Fingers								
			Hip-joint								
			Thigh	{ At upper third							
				{ At middle third							
				{ At lower third							
			Leg								
		Ankle-joint									
		Medio-tarsus									
		Tarso-metatarsus									
		Toes									
Trephining											
Ligation of Arteries											
Total											

CLASSIFIED RETURN OF WOUNDS AND INJURIES OF EVERY KIND received in action and abroad, admitted into the Hospital of _____ between the _____ of _____ 18____.

N. B.—Separate forms should be used for (1) officers, and for (2) non-commissioned officers and men.
[A separate form may be used for Gun-shot Wounds as distinguished from other wounds.]

REGIONS OF THE BODY WOUNDED OR INJURED.	Remained on the 18	Since admitted.	Amputation.			Other Operations.	Died.	Discharged to duty.	To other Hospitals.	Transferred.	Remainings on the 18
			Primary.	Secondary.	Excision.						
All Wounds and Injuries.											
1. Wounds of the Head											
2. Wounds of the Face											
3. Wounds of the Neck											
4. Wounds of the Chest											
5. Wounds of the Abdomen											
6. Wounds of the Back and Spine											
7. Wounds of the Perineum and Genital and Urinary Organs, not being wounds of the Peritoneum											
8. Wounds of the Upper Extremities											
9. Wounds of the Lower Extremities											
10. Wounds with direct injuries of the Large Arteries, not being Cases of Compound Fracture.											
11. Wounds with direct Penetration or Perforation of the Large Joints											
12. Wounds with direct injury of Large Nerves, not being at the same time Cases of Compound Fracture											

N. B.—The classification may be continued by the expansion of each of these heads so as to show the precise character of the wounds and injuries.

FORMULARY OF PRESCRIPTIONS.

ANTISEPTICS.

1. Solution of Chlorinated Soda.

Used locally in all affections attended with fœtor, and may be applied diluted as a gargle, wash, poultice, or by lint. Also as a disinfecting agent.

2. Solution of Permanganate of Potash.*

(a.) *Dressings for Ulcers, Sores, &c.*—Keep applied a piece of soft lint or rag, which moisten frequently with the fluid, more or less diluted with water according to circumstances. Very foul and sluggish sores require the fluid from the full strength to that of 2 oz. to a pint of water; in other cases $\frac{1}{2}$ fl. oz. to the pint.

(b.) *Poultices.*—Add 2 tea-spoonfuls of the fluid to the water used in making, and before applying pour a few drops on the surface of the poultice.

(c.) *Injections.*—Two tea-spoonfuls to a pint of water, gradually increasing the strength.

(d.) *Fomentations.*—One table-spoonful to a pint of warm water.

* Condy's Disinfectant is double the strength of the Solution of Permanganate of Potash in the British Pharmacopœia.

3. Sir William Burnett's Solution of Chloride of Zinc.

	Proportions of Mixture.
To purify sick rooms, wards of hospitals	1 to 100 of water.
To deprive night-chairs, &c., of offensive odour.	
To deodorize cesspools and open privies, &c.	

BATHS.

1. Simple Bath.

	Temperature.
Hot bath	98° to 105° Fahr.
Warm „	92 „ 98 „
Tepid „	85 „ 92 „
Cold „	56 „ 64 „

2. Compound Sulphur Bath.

Take of—

Precipitated sulphur	2 oz.
Hyposulphite of soda	1 oz.
Diluted sulphuric acid	$\frac{1}{2}$ fl. oz.
Water	30 C.
	Mix.

3. Acid Bath.

Take of—

Nitric acid	$1\frac{1}{2}$ fl. oz.
Hydrochloric acid	1 fl. oz.
Water	30 C.
	Mix.

4. Alkaline Bath.

Take of—	
Carbonate of soda	4 oz.
Water	30 C.
Mix.	

5. Iodine Bath.

Take of—	
Iodine	$\frac{1}{4}$ oz.
Solution of potash	2 fl. oz.
Water	30 C.
Mix.	

6. Mustard Foot Bath.

Take of—	
Mustard, in powder	2 oz.
Hot water	4 C.
Mix.	

CATAPLASMS. POULTICES.

1. Charcoal Poultice.

Take of—	
Wood charcoal, in powder . .	$\frac{1}{2}$ oz.
Bread	2 oz.
Linseed meal	$1\frac{1}{2}$ oz.
Boiling water	10 fl. oz.

Macerate the bread in the water for a short time, near the fire, then mix, and add the linseed meal, gradually stirring the ingredients, that a soft poultice may be formed; mix with this half the charcoal, and sprinkle the remainder on the surface of the poultice.

2. Chlorine Poultice.

Take of—	
Solution of chlorinated soda .	2 fl. oz.
Linseed meal	4 oz.
Boiling water	8 fl. oz.

Add the linseed meal gradually to the water, stirring constantly; then mix in the solution of chlorinated soda.

3. Linseed Meal Poultice.

Take of—	
Linseed meal	4 oz.
Olive oil	$\frac{1}{2}$ fl. oz.
Boiling water	10 fl. oz.
Mix the linseed meal with the oil, then add the water gradually, constantly stirring.	

4. Mustard Poultice.

Take of—	
Mustard, in powder	$2\frac{1}{2}$ oz.
Linseed meal	$2\frac{1}{2}$ oz.
Boiling water	10 fl. oz.

Mix gradually the linseed meal with the water, and add the mustard, constantly stirring.

CAUSTICS.

1. Compound Savin.

Take of—	
Fresh savin, in powder . . .	60 grs.
Burnt alum	15 grs.
Levigated red precipitate . .	15 grs.
Mix.	

2. Of Chloride of Zinc.

Take of—	
Chloride of zinc	1 part.
Fine flour	2 to 5 parts.
Mix.	

COLLYRIA.

1. Collyrium of Alum.

Take of—	
Alum	$3\frac{1}{2}$ grs.
Distilled water	1 fl. o.
Mix.	

2. Of Nitrate of Silver.

Take of—	
Nitrate of silver	1 gr.
Distilled water	1 fl. oz.
Mix.	

3. Of Sulphate of Copper.

Take of—

Sulphate of copper	. . .	6 grs.
Distilled water	. . .	1 fl. oz.
Mix.		

4. Of Opium.

Take of—

Tincture of opium	. . .	30 min.
Distilled water	. . .	1 fl. oz.
Mix.		

ELECTUARIES.

1. Of Senna.

Take of—

Confection of senna	. . .	2 oz.
Jalap, in powder	. . .	60 grs.
Acid tartrate of potash	. . .	120 grs.
Mix.		

2. Of Sulphur.

Take of—

Precipitated sulphur	. . .	120 grs.
Acid tartrate of potash	. . .	30 grs.
Treacle	. . .	6 fl. drms.
Mix.		

DECOCTIONS.

1. Compound of aloes	. . .	} British Pharma- copoeia.
2. Of yellow bark	. . .	
3. Of logwood	. . .	
4. Of poppies	. . .	
5. Of oak bark	. . .	
6. Of taraxacum	. . .	
7. Compound of sarsaparilla	. . .	

DRAUGHTS (Antispasmodic).

1. Of Ether and Opium.

Take of—

Spirit of ether	. . .	30 min.
Tincture of opium	. . .	20 min.
Peppermint water	. . .	1½ fl. oz.
Mix.		

2. Of Chloroform.

Take of—

Chloroform	. . .	5 min.
Camphor	. . .	5 grs.
Mucilage	. . .	1 fl. drms.
Water	. . .	10 fl. drms.
Mix.		

DRAUGHTS (Astringent).

1. Of Iron and Calumba.

Take of—

Tincture of perchloride of iron	. . .	15 min.
Infusion of calumba	. . .	1 fl. oz.
Mix.		

2. Of Turpentine.

Take of—

Oil of turpentine	. . .	10 min.
Mucilage of gum arabic	. . .	1 fl. oz.
Mix.		

3. Of Quinia and Sulphuric Acid.

Take of—

Sulphate of quinia	. . .	2 grs.
Dilute sulphuric acid	. . .	30 min.
Compound tincture of cardamoms	. . .	1 fl. drms.
Distilled water	. . .	1½ fl. oz.
Mix.		

DRAUGHTS (Cathartic).

1. Black Draught.

Take of—

Sulphate of magnesia	. . .	½ oz.
Tincture of jalap	. . .	1 fl. drms.
Infusion of senna	. . .	1½ fl. oz.
Mix.		

2. Rhubarb and Magnesia.

Take of—

Rhubarb, in powder	. . .	20 grs.
Carbonate of magnesia	. . .	15 grs.
Sulphate of magnesia	. . .	120 grs.
Peppermint water	. . .	1½ fl. oz.
Mix.		

3. Warm Aperient.

Take of—

Extract of rhubarb	. . .	10 grs.
Phosphate of soda	. . .	60 grs.
Compound decoction of aloes	1 fl. oz.	
Mix.		

DRAUGHTS (Antacid).**1. Bicarbonate of Potash.**

Take of—

Bicarbonate of potash	. . .	30 grs.
Water	. . .	1 fl. oz.
Mix.		

2. Carbonate of Ammonia.

Take of—

Carbonate of ammonia	. . .	5 grs.
Tincture of orange peel	. . .	1 fl. drm.
Infusion of chiretta	. . .	7 fl. drms.
Mix.		

3. Bicarbonate of Soda and Creasote.

Take of—

Bicarbonate of soda	. . .	10 grs.
Creasote	. . .	1 min.
Infusion of calumba	. . .	1½ fl. oz.
Mix.		

DRAUGHTS (Anthelmintic).**1. Of Fern Root.**

Take of—

Liquid extract of fern root	40 min.
Tincture of ginger	. . . 15 min.
Refined sugar	. . . 20 grs.
Mucilage of gum arabic	. . . 1 fl. drm.
Water	. . . 1½ fl. oz.
Mix.	

2. Of Kamela.

Take of—

Kamela, in powder	. . .	90 grs.
Aromatic powder	. . .	10 grs.
Mucilage of gum arabic	. . .	½ oz.
Water	. . .	1½ fl. oz.
Mix.		

3. Of Kousso.

Take of—

Kousso	. . .	¼ oz.
Boiling distilled water	. . .	4 fl. oz.
Mix.		

4. Of Turpentine and Castor Oil.

Take of—

Oil of turpentine	. . .	1 fl. oz.
Castor oil	. . .	1 fl. oz.
Mix.		

DRAUGHTS (Diaphoretic).**1. Of Acetate of Ammonia.**

Take of—

Solution of acetate of ammonia	. . .	40 min.
Water	. . .	½ fl. oz.
Mix.		

2. Of Citrate of Ammonia.

Take of—

Carbonate of ammonia	. . .	16 grs.
Citric acid	. . .	20 grs.
Water	. . .	1½ fl. oz.
Mix.		

DROPS (Eye).**1. Of Hydrocyanic Acid.**

Take of—

Dilute hydrocyanic acid	. . .	1 fl. drm.
Distilled water	. . .	1 fl. oz.
Mix.		

2. Of Atropia.

Take of

Atropia, in crystals	. . .	4 grs.
Rectified spirit	. . .	1 fl. drm.
Distilled water	. . .	1 fl. oz.
Mix.		

3. Of Sulphate of Zinc.

Take of—

Sulphate of zinc	. . .	2 grs.
Distilled water	. . .	1 fl. oz.
Mix.		

ENEMATA (Nutritive).

1. Of Cod-liver Oil.

Take of—

Cod-liver oil	. . .	1 fl. oz.
Essence of beef	. . .	4 fl. oz.
Brandy	. . .	$\frac{1}{2}$ fl. oz.
Milk	. . .	$\frac{1}{2}$ oz.
Tincture of opium	. . .	20 min.
Mix.		

2. Of Quinine and Beef Tea.

Take of—

Sulphate of quinine	. . .	6 grs.
Brandy	. . .	$\frac{1}{2}$ fl. oz.
Milk	. . .	1 fl. oz.
Strong beef tea	. . .	6 to 8 fl. oz.
Mix.		

ENEMATA (Purgative).

1. Of Sulphate of Magnesia.

Take of—

Sulphate of magnesia	. . .	1 oz.
Olive oil	. . .	1 fl. oz.
Mucilage of starch	. . .	15 fl. oz.
Mix.		

2. Of Castor Oil.

Take of—

Castor oil	. . .	2 fl. oz.
Mucilage of starch	. . .	8 fl. oz.
Mix.		

3. Of Soap.

Take of—

Soft soap	. . .	1 oz.
Boiling water	. . .	1 O.
Mix.		

4. Of Turpentine.

Take of—

Oil of turpentine	. . .	1 fl. oz.
Mucilage of starch	. . .	15 fl. oz.
Mix.		

ENEMATA (Sedative).

1. Of Opium.

Take of—

Tincture of opium	. . .	30 min.
Mucilage of starch	. . .	2 fl. oz.
Mix.		

ENEMATA (Antispasmodic).

1. Of Assafoetida.

Take of—

Tincture of assafoetida	. . .	6 fl. drms.
Mucilage of starch	. . .	6 fl. oz.

FOMENTATIONS.

1. Spongio-piline, wrung out of hot water, and applied.

2. Of Turpentine.

Flannel or spongio-piline wrung out of hot water, and sprinkled with turpentine.

3. Of Poppies.

Take of—

Capsules, sliced or bruised	. . .	3 to 5
Water	. . .	2 O.

Boil for a quarter of an hour.

GARGLES.

1. Of Hydrochloric Acid.

Take of—

Dilute hydrochloric acid	. . .	1 fl. drm.
Treacle	. . .	1 fl. drm.
Water	. . .	2 fl. oz.
Mix.		

2. Of Borax.

Take of—

Borax	. . .	$\frac{1}{2}$ oz.
Tincture of myrrh	. . .	1 fl. oz.
Water	. . .	10 $\frac{1}{2}$ fl. oz.
Mix.		

3. Of Chlorinated Soda.

Take of—
 Solution of chlorinated soda 1 fl. oz.
 Water 11 fl. oz.
 Mix.

4. Of Tannic Acid.

Take of—
 Tannic acid 60 grs.
 Treacle 2 fl. drms.
 Water 4 fl. oz.
 Mix.

5. Of Alum.

Take of—
 Alum 60 grs.
 Dilute sulphuric acid 1 fl. drms.
 Treacle 4 fl. drms.
 Water 15 fl. oz.
 Mix.

INFUSIONS.

1. Of Buchu	} British Pharma- copœia.
2. „ Calumba	
3. „ Chamomile	
4. „ Cascarilla	
5. „ Catechu	
6. „ Chiretta	
7. „ Digitalis	
8. „ Gentian (comp.)	
9. „ Linseed	
10. „ Quassia	
11. „ Senna	
12. „ Yellow Bark	

INHALATIONS.**1. Of Hydrocyanic Acid.**

Take of—
 Dilute hydrocyanic acid 10 to 15 min.
 Hot water 10 fl. oz.
 Mix. Put into an inhaler.

2. Of Turpentine.

Take of—
 Oil of turpentine 1 fl. oz.
 Hot water 4 fl. oz.
 Mix. Put into an inhaler.

INJECTIONS.**1. Of Nitrate of Silver.**

Take of—
 Nitrate of silver 1½ grs.
 Distilled water 1 fl. oz.
 Mix.

2. Of Lime Water with Lead.

Take of—
 Solution of subacetate of
 lead 3 min.
 Olive oil 2 fl. drms.
 Lime water 1 fl. oz.
 Mix.

3. Of Sulphate of Zinc.

Take of—
 Sulphate of zinc 3 grs.
 Solution of subacetate of lead 20 min.
 Distilled water 1 fl. oz.
 Mix.

LOTIONS.**1. Of Hydrocyanic Acid.**

Take of—
 Dilute hydrocyanic acid 4 fl. drms.
 Acetate of lead 15 grs.
 Rectified spirit 4 fl. drms.
 Water 7 fl. oz.
 Mix.

2. Of Creasote.

Take of—
 Creasote 1 fl. drms.
 Glycerine 3 fl. oz.
 Water 9 fl. oz.
 Mix.

3. Of Nitro-Hydrochloric Acid.

Take of—
 Nitric acid 3 min.
 Hydrochloric acid 6 min.
 Water 1 fl. oz.
 Mix.

4. Of Carbonate of Potash.

Take of—

Carbonate of potash . . .	24 grs.
Water . . .	1 fl. oz.
Mix.	

5. Of Sulphurous Acid.

The solution of sulphurous acid is made by passing a stream of the gas through water to saturation.

Take of—

This solution . . .	2 fl. oz.
Water . . .	6 fl. oz.
Mix.	

6. Of Borax and Glycerine.

Take of—

Borax . . .	20 grs.
Glycerine . . .	1 fl. oz.
Water . . .	8 fl. oz.
Mix.	

7. Of Arnica.

Take of—

Tincture of arnica . . .	1½ fl. drms.
Water . . .	1½ fl. drms.
Mix.	

8. Of Subacetate of Lead.

Take of—

Solution of subacetate of lead . . .	2 fl. drms.
Glycerine . . .	2 fl. oz.
Water . . .	10 fl. oz.
Mix.	

9. Of Chlorinated Lime.

Take of—

Solution of chlorinated lime . . .	18 min.
Water . . .	6 fl. oz.
Mix.	

10. Of Corrosive Sublimate and Lime Water (Yellow Wash).

Take of—

Corrosive sublimate . . .	1 gr.
Lime water . . .	1 fl. oz.
Mix.	

11. Of Calomel and Lime Water (Black Wash).

Take of—

Calomel . . .	3 grs.
Lime water . . .	1 fl. oz.
Mix.	

12. Of Sulphate of Zinc and Lavender (Red Wash).

Take of—

Sulphate of zinc . . .	1 gr.
Comp. tincture of lavender . . .	15 min.
Water . . .	1 fl. oz.
Mix.	

13. Of Sulphate of Zinc.

Take of—

Sulphate of zinc . . .	1 gr.
Water . . .	1 fl. oz.
Mix.	

FREEZING MIXTURES.

Take of— No. 1.

Sal-ammoniac, 5 parts	{ Thermometer sinks from 50° to 10° Fahr.
Nitre . . . 5 "	
Water . . . 16 "	
Mix.	

Take of— No. 2.

Snow . . .	{ Thermometer sinks from 32° to 0 Fahr
Common salt . . .	
Mix.	

LINIMENTS.

1. Of Aconite . . .	} British Pharma- copoeia.
2. „ Ammonia . . .	
3. „ Lime . . .	
4. „ Belladonna . . .	
5. „ Camphor (comp.) . . .	
6. „ Cantharides . . .	
7. „ Chloroform . . .	
8. „ Mercurry . . .	
9. „ Opium . . .	
10. „ Soap . . .	
11. „ Turpentine . . .	
12. „ Iodine . . .	

13. Of Croton Oil.

Take of—

Croton oil	1 fl. drms.
Comp. camphor liniment	7 fl. drms.
Mix.	

14. Of Belladonna and Opium.

Take of—

Extract of belladonna	120 grs.
Tincture of opium	2 fl. oz.
Glycerine	3 fl. oz.
Water	2 fl. oz.
Mix.	

15. Of Sulphuret of Lime.

Take of—

Quick lime	1 part.
Sublimed sulphur	2 parts.
Water	10 parts.
Mix.	

Boil, constantly stirring with a piece of wood, until the lime and sulphur are perfectly combined. Decant, and keep in a well-stoppered bottle.

Wash the body well with warm water, and then rub the liquid into the skin for half an hour. For Psora.

MIXTURES (Alterative and Resolvent).

1. Of Iodide of Potassium.

Take of—

Iodide of potassium	20 grs.
Distilled water	6 fl. oz.
Mix. Dose, an ounce.	

2. Of Iodide of Potassium and Sarsaparilla.

Take of—

Iodide of potassium	20 grs.
Comp. decoct. of sarsaparilla	1 O.
Mix. Dose, 4 fl. oz.	

3. Of Quinia and Arsenic.

Take of—

Sulphate of quinia	1 drms.
Arsenical solution	2 fl. drms.
Dilute sulphuric acid	1 fl. drms.
Tincture of bark	2 fl. oz.
Tincture of ginger	$\frac{1}{2}$ fl. drms.
Refined sugar	20 grs.
Mix. Dose, 1 fl. drms., after meals.	

MIXTURES (Alterative).

1. Of Chlorate of Potash and Bark.

Take of—

Chlorate of potash	90 grs
Compound tincture of cinchona	6 fl. drms.
Infusion of yellow cinchona	6 fl. oz.
Mix. Dose, an ounce.	

2. Of Nitro-Hydrochloric Acid.

Take of—

Dilute nitric acid	$\frac{1}{2}$ fl. drms.
Dilute hydrochloric acid	1 fl. drms.
Infusion of quassia	6 fl. oz.
Mix. Dose, an ounce.	

3. Of Bromide of Potassium.

Take of—

Bromide of potassium	24 grs.
Water	7 fl. oz.
Mix. Dose, an ounce.	

4. Of Turpentine.

Take of—

Oil of turpentine	1 fl. oz.
Yolk of one egg.	

Mix well, and add gradually

Mucilage of gum arabic	2 fl. drms
Tincture of orange peel	2 fl. drms
Compound tincture of lavender	4 fl. drms
Water	5 $\frac{1}{2}$ fl. oz.
Mix. Dose, half an ounce.	

5. Of Soda and Gum Arabic.

Take of—

Mucilage of gum arabic	. ½ fl. oz.
Tincture of hyoscyamus	. 1½ fl. drms.
Bicarbonate of soda	. 90 grs.
Water	. 8 fl. oz.

Mix. Dose, an ounce.

MIXTURES (Sedative).

1. Of Hydrocyanic Acid and Soda.

Take of—

Dilute hydrocyanic acid	. 18 min.
Bicarbonate of soda	. 90 grs.
Water	. 6 fl. oz.

Mix. Dose, an ounce.

MIXTURES (Antacid).

1. Of Ammonia and Bark.

Take of—

Carbonate of ammonia	. 60 grs.
Chlorate of potash	. 120 grs.
Decoction of bark	. 12 fl. oz.

; Mix. Dose, an ounce.

2. Of Bismuth and Gentian.

Take of—

White bismuth	. 42 grs.
Dilute hydrocyanic acid	. 30 min.
Mucilage of gum arabic	. ½ fl. oz.
Infusion of gentian	. 6 fl. oz.

Mix. Dose, half an ounce.

MIXTURES (Antispasmodic).

1. Of Lobelia and Ether.

Take of—

Etherial tincture of lobelia	. 3 fl. drms.
Camphor water	. 5½ fl. oz.

Mix. Dose, an ounce.

2. Of Ammonia in Effervescence.

Take of—

Carbonate of ammonia	. 90 grs.
Water	. 3 fl. oz.

Mix. Dose, an ounce, with 18 grs. of citric acid.

3. Of Spirit of Chloroform (Chloric Ether).

Take of—

Spirit of chloroform	. 2 fl. drms.
Syrup of squills	. 3 fl. drms.
Tincture of opium	. 20 min.
Water	. 6 fl. oz.

Mix. Dose, an ounce.

MIXTURES (Astringent).

1. Of Bismuth.

Take of—

White bismuth	. 1 drms.
Mucilage of gum arabic	. 3 fl. oz.
Water	. 3 fl. oz.

Mix. Dose, an ounce.

2. Of Chalk and Opium.

Take of—

Tincture of catechu	. 3 fl. drms.
Aromatic confection	. 90 grs.
Tincture of opium	. 30 min.
Chalk mixture	. 6 fl. oz.

Mix. Dose, an ounce.

3. Of Gallic Acid.

Take of—

Gallic acid	. 40 grs.
Camphorated tincture of opium	. 2½ fl. drms.
Dilute sulphuric acid	. 1 fl. drms.
Water	. 8 fl. oz.

Mix. Dose, an ounce.

4. Of Tannic Acid.

Take of—

Tannic acid	. 40 grs.
Dilute nitric acid	. ½ fl. drms.
Treacle	. 2 fl. drms.
Infusion of gentian	. 8 fl. oz.

Mix. Dose, an ounce.

5. Of Nitric Acid.

Take of—

Dilute nitric acid	. . . 1½ fl. drms.
Infusion of cascarrilla.	. . . 8 fl. oz.
Mix.	Dose, an ounce.

6. Of Logwood.

Take of—

Lime water	. . . 2 fl. oz.
Decoction of logwood	. . . 6 fl. oz.
Mix.	Dose, an ounce.

7. Of Creasote.

Take of—

Creasote	. . . 16 min.
Glacial acetic acid	. . . 16 min.
Spirit of juniper	. . . ½ fl. drms.
Syrup	. . . 1 fl. oz.
Distilled water	. . . 15 fl. oz.

Mix the creasote with the acetic acid, gradually add the water, and lastly the syrup and spirit of juniper.

Dose, 1 or 2 ounces.

8. Of Sulphuric Acid, Alum, and Magnesia.

Take of—

Dilute sulphuric acid	. . . 2 fl. drms.
Alum	. . . 80 grs.
Sulphate of magnesia	. . . ½ oz.
Water	. . . 8 fl. oz.

Mix. Dose, an ounce.

MIXTURES (Cathartic and Anthelmintic).

1. Of Magnesia and Antimony.

Take of—

Sulphate of magnesia	. . . 1 oz.
Antimonial wine	. . . 1 fl. drms.
Syrup of poppies	. . . 3 fl. drms.
Solution of acetate of ammonia	. . . 2 fl. drms.
Camphor mixture	. . . 5 fl. oz.

Mix. Dose, an ounce.

2. Of Magnesia and Sulphuric Acid.

Take of—

Sulphate of magnesia	. . . 1 oz.
Dilute sulphuric acid	. . . 1 fl. drms.
Treacle	. . . 1 fl. oz.
Peppermint water	. . . 8 fl. oz.
Mix.	Dose, an ounce.

3. Of Magnesia and Senna.

Take of—

Sulphate of magnesia	. . . 1 oz.
Tincture of ginger	. . . 2 fl. drms.
Aromatic spirit of ammonia	. . . 2 fl. drms.
Tincture of senna	. . . ½ fl. oz.
Infusion of senna	. . . 8 fl. oz.
Mix.	Dose, an ounce.

MIXTURES (Diaphoretic).

1. Of Acetate of Ammonia.

Take of—

Solution of acetate of ammonia	. . . 2 fl. drms.
Tartarated antimony	. . . ½ gr.
Spirit of nitrous ether	. . . 2 fl. drms.
Water	. . . 7 fl. oz.
Mix.	Dose, an ounce.

2. Of Potash and Magnesia.

Take of—

Nitrate of potash	. . . 30 grs.
Sulphate of magnesia	. . . 1½ oz.
Tincture of hyoscyamus	. . . 1 fl. drms.
Mucilage of gum arabic	. . . 1 fl. oz.
Water	. . . 8 fl. oz.
Mix.	Dose, an ounce.

MIXTURES (Diuretic).

1. Of Acetate of Potash.

Take of—

Acetate of potash	. . . 90 grs.
Syrup of squills	. . . 1½ fl. drms.
Decoction of broom	. . . 8 fl. oz.
Mix.	Dose, an ounce.

2. Of Nitrate of Potash and Buchu.

Take of—

Nitrate of potash . . .	30	grs.
Spirit of nitrous ether . .	$\frac{1}{2}$	fl. oz.
Compound spirit of juniper . . .	3	fl. drms.
Infusion of buchu . . .	7	fl. oz.
Mix. Dose, half an ounce.		

MIXTURES (Expectorant).

1. Of Squills and Conium.

Take of—

Tincture of squills . . .	80	min.
Solution of potash . . .	1	fl. drms.
Juice of conium . . .	$1\frac{1}{2}$	fl. drms.
Camphor water . . .	8	fl. oz.
Mix. Dose, an ounce.		

2. Of Senega.

Take of—

Camphorated tincture of opium . . .	4	fl. drms.
Tincture of tolu . . .	2	fl. drms.
Refined sugar . . .	20	grs.
Decoction of senega . . .	7	fl. oz.
Mix. Dose, an ounce.		

3. Of Soda and Gum Arabic.

Take of—

Bicarbonate of soda . . .	80	grs.
Tincture of hyoscyamus . .	2	fl. drms.
Mucilage of gum arabic . .	$\frac{1}{2}$	fl. oz.
Water . . .	$7\frac{1}{2}$	fl. oz.
Mix. Dose, an ounce.		

4. Of Ipecacuan and Gum Arabic.

Take of—

Ipecacuan wine . . .	2	fl. drms.
Mucilage of gum arabic . .	2	fl. oz.
Syrup of squills . . .	3	fl. drms.
Water . . .	$7\frac{1}{2}$	fl. oz.
Mix. Dose, an ounce.		

5. Of Ipecacuan and Opium.

Take of—

Wine of ipecacuan . . .	2	fl. drms.
Tincture of opium . . .	40	min.
Nitrate of potash . . .	80	grs.
Mucilage of gum arabic . .	$\frac{1}{2}$	fl. oz.
Water . . .	8	fl. oz.
Mix. Dose, an ounce.		

6. Of Hydrocyanic Acid and Morphia.

Take of—

Dilute hydrocyanic acid . .	4	min.
Solution of hydrochlorate of morphia . . .	15	min.
Treacle . . .	4	fl. drms.
Water . . .	6	fl. oz.
Mix. Dose, half an ounce.		

MIXTURES (Stimulant).

1. Of Citrate of Potash and Calumba.

Take of—

Bicarbonate of potash . .	120	grs.
Aromatic spirit of ammonia . . .	$1\frac{1}{2}$	fl. drms.
Spirit of chloroform . . .	1	fl. drms.
Dilute hydrocyanic acid . .	25	min.
Tincture of calumba . . .	6	fl. drms.
Infusion of calumba . . .	12	fl. oz.
Mix. Dose, 2 ounces, with 1 of lemon juice, or with 14 grs. of citric acid.		

2. Of Ammonia and Cascarilla.

Take of—

Carbonate of ammonia . . .	30	grs.
Infusion of cascarilla . . .	6	fl. oz.
Mix. Dose, an ounce.		

3. Of Taraxacum.

Take of—

Extract of taraxacum . . .	180	grs.
Dilute nitric acid . . .	40	min.
Water . . .	8	fl. oz.
Mix. Dose, an ounce.		

MIXTURES (Tonic).**1. Of Nux Vomica.**

Take of—

Tincture of nux vomica	. 1 fl. drm.
Infusion of gentian	. 8 fl. oz.
Mix. Dose, an ounce.	

2. Of Perchloride of Iron.

Take of—

Solution of perchloride of iron	. 1 fl. drm.
Hydrochlorate of ammonia	. 60 grs.
Water	. 6 fl. oz.
Mix. Dose, an ounce.	

3. Of Iron and Calumba.

Take of—

Citrate of iron and ammonia	. 30 grs.
Infusion of calumba	. 6 fl. oz.
Mix. Dose, an ounce.	

4. Of Iron and Quinia.

Take of—

Citrate of iron and quinia	. 60 grs.
Water	. 6 oz.
Mix. Dose, half an ounce to an ounce.	

OINTMENTS.

1. Of Aconite
2. „ Tartarated antimony
3. „ Atropia
4. „ Belladonna
5. „ Creasote
6. „ Galls
7. „ Red iodide of mercury
8. „ Nitrate of mercury
9. „ Mercury
10. „ Red oxide of mercury
11. „ Subacetate of lead
12. „ Simple ointment

British
Pharma-
copœia.

PIGMENTS.**1. Of Iodine.**

Take of—

Iodine	. 60 grs.
Iodide of potassium	. 40 grs.
Rectified spirit	. 1 fl. oz.
Mix.	

2. Of Iodine (Weaker).

Take of—

Iodine	. 30 grs.
Iodide of potassium	. 20 grs.
Rectified spirit	. 1 fl. oz.
Mix.	

PILLS (Astringent and Anti-spasmodic).**1. Of Gallic Acid and Morphia.**

Take of—

Gallic acid	. 2½ grs.
Hydrochlorate of morphia	. ½ gr.
Mucilage of gum arabic	. q. s.
Mix. Make a pill.	

2. Of Copper and Opium.

Take of—

Sulphate of copper	. ¼ gr.
Opium in powder	. ¼ gr.
Confection of roses	. q. s.
Mix. Make a pill.	

3. Of Lead and Opium.

Take of—

Acetate of lead	. 1 gr.
Opium in fine powder	. ½ gr.
Confection of roses	. q. s.
Mix. Make a pill.	

PILLS (Cathartic).

1. Of Colocynth, Scammony, and Calomel.

Take of—

Compound colocynth pill	3 grs.
Scammony, in powder	3 grs.
Oil of cinnamon	2 min.
Calomel	3 grs.
Mix. Divide into two pills.	Two for a dose.

2. Of Colocynth and Croton Oil.

Take of—

Compound pill of colocynth	26 grs.
Compound pill of gamboge	12 grs.
Capsicum	6 grs.
Croton oil	1 min.
Mix. Make twelve pills.	One for a dose.

3. Of Rhubarb and Mercury.

Take of—

Compound pill of rhubarb	4 grs.
Mercurial pill	1 gr.
Mix. Make one pill.	

4. Of Podophyllum.

Take of—

Resin of podophyllum, in fine powder	1 gr.
Extract of hyoseyamus	6 grs.
Extract of liquorice	5 grs.
Mix. Make four pills.	One for a dose.

PILLS (Alterative).

1. Of Aloes and Myrrh.

Take of—

Pill of aloes and myrrh	2½ grs.
Compound assafoetida pill	2½ grs.
Mix. Make one pill.	

PILLS (Diuretic).

1. Of Squill and Ipecacuan.

Take of—

Compound squill pill	2½ grs.
Powder of ipecacuan and opium	2½ grs.
Treacle	q. s.
Mix. Make one pill.	

2. Of Elaterium.

Take of—

Elaterium, in fine powder	½ gr.
Extract of hyoseyamus	1 gr.
Extract of gentian	3 grs.
Mix. Make one pill.	

3. Of Squill and Digitalis.

Take of—

Squill, in fine powder	2 grs.
Extract of conium	2 grs.
Digitalis in powder	1 gr.
Mix. Make one pill.	

PILLS (Sedative).

1. Of Conium and Morphia.

Take of—

Extract of conium	4 grs.
Ipecacuan, in powder	½ gr.
Hydrochlorate of morphia	⅛ gr.
Mix. Make one pill.	

2. Of Squill and Morphia.

Take of—

Squill, in powder	2 grs.
Hydrochlorate of morphia	⅛ gr.
Ipecacuan, in powder	½ gr.
Mix. Make one pill.	

3. Of Stramonium.

Take of—

Extract of stramonium	4 gr.
Extract of liquorice	3 grs.
Mix. Make one pill.	

4. Of Oxide of Zinc.

Take of—

Oxide of zinc, in fine powder 2½ grs.
 Extract of liquorice . . . 2 grs.
 Mix. Make one pill.

5. Of Zinc and Hyoscyamus.

Take of—

Oxide of zinc, in fine powder . . 2 grs.
 Extract of hyoscyamus . . . 2 grs.
 Mix. Make one pill.

PLASTERS.

1. Ammonia and mercury . . .	} British Pharma- copœia.
2. Belladonna . . .	
3. Warm plaster . . .	
4. Iron . . .	
5. Galbanum . . .	
6. Mercury . . .	
7. Opium . . .	
8. Pitch . . .	
9. Soap . . .	

POWDERS.

1. Of Soda and Potash (in effervescence).

Take of—

Tartrate of soda and potash. 120 grs.
 Bicarbonate of soda. . . 40 grs.
 Mix. In a separate paper 37 grs. of
 tartaric acid.

2. Of Calomel and Jalap.

Take of—

Calomel 4 grs.
 Jalap 15 grs.
 Ginger 2 grs.
 Sugar 2 grs.
 Mix. One for a dose.

3. Of Ipecacuan and Antimony.

Take of—

Ipecacuan, in powder . . . 20 grs.
 Tartarated antimony . . . 1 gr.
 Mix. One for a dose.

4. Of Galls and Tannic Acid.

Take of—

Galls, in powder . . . 8 grs.
 Tannic acid . . . 1 gr.
 Bicarbonate of soda . . . 1 gr.
 Mix. One for a dose.

5. Of Kino and Alum.

Take of—

Powder of kino and opium . . 5 grs.
 Alum 2 grs.
 Mix. One for a dose.

SUPPOSITORIES.

1. Of Opium.

Take of—

Opium, in powder . . . 2 grs.
 Hard soap 20 grs.
 Mix.

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